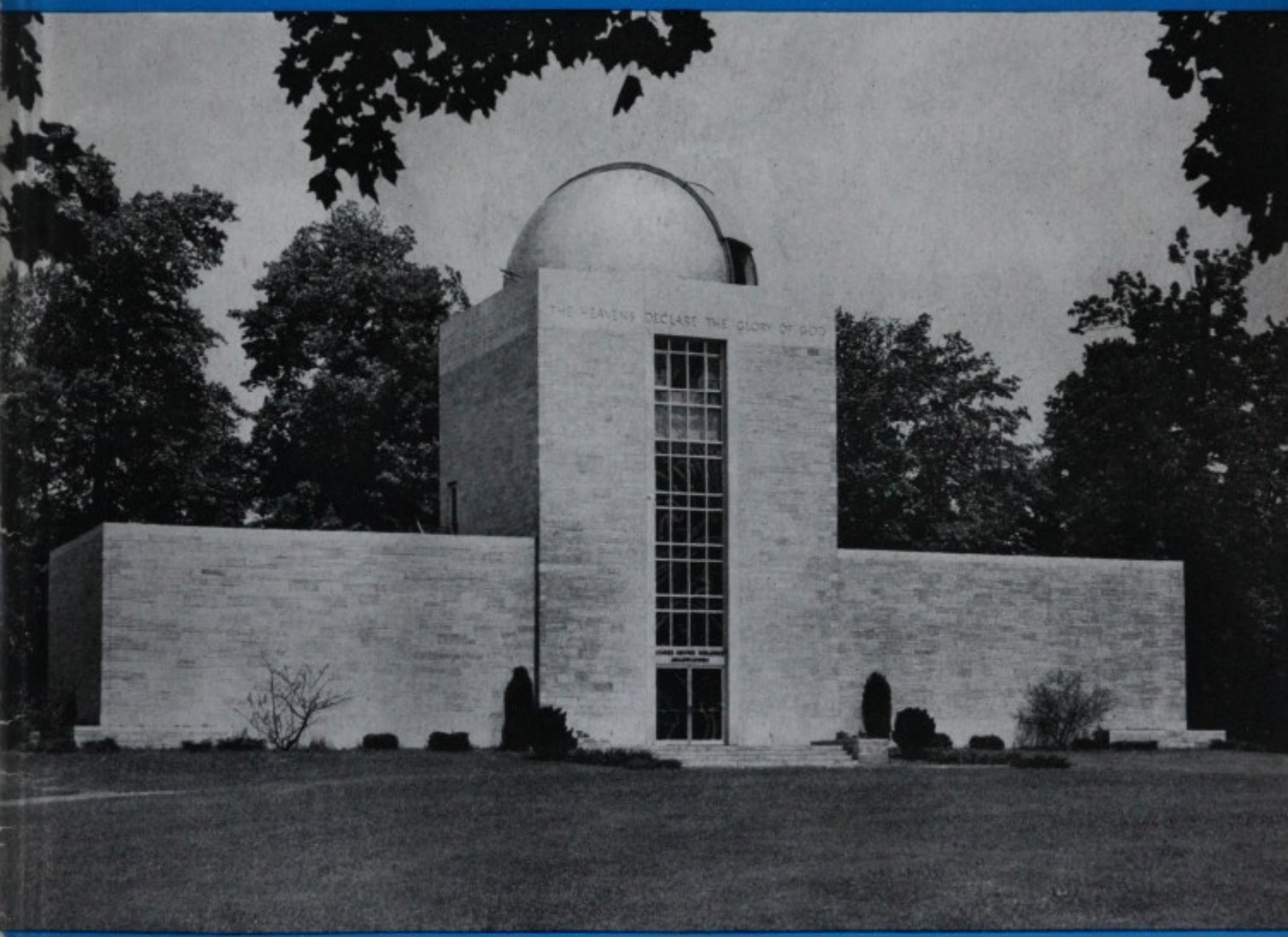
# Sky and TELESCOPE




Holcomb Observatory and Planetarium

## *In This Issue:*

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Vol. XIV, No. 10

AUGUST, 1955

40 cents

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June Eclipse Observers Partly Successful

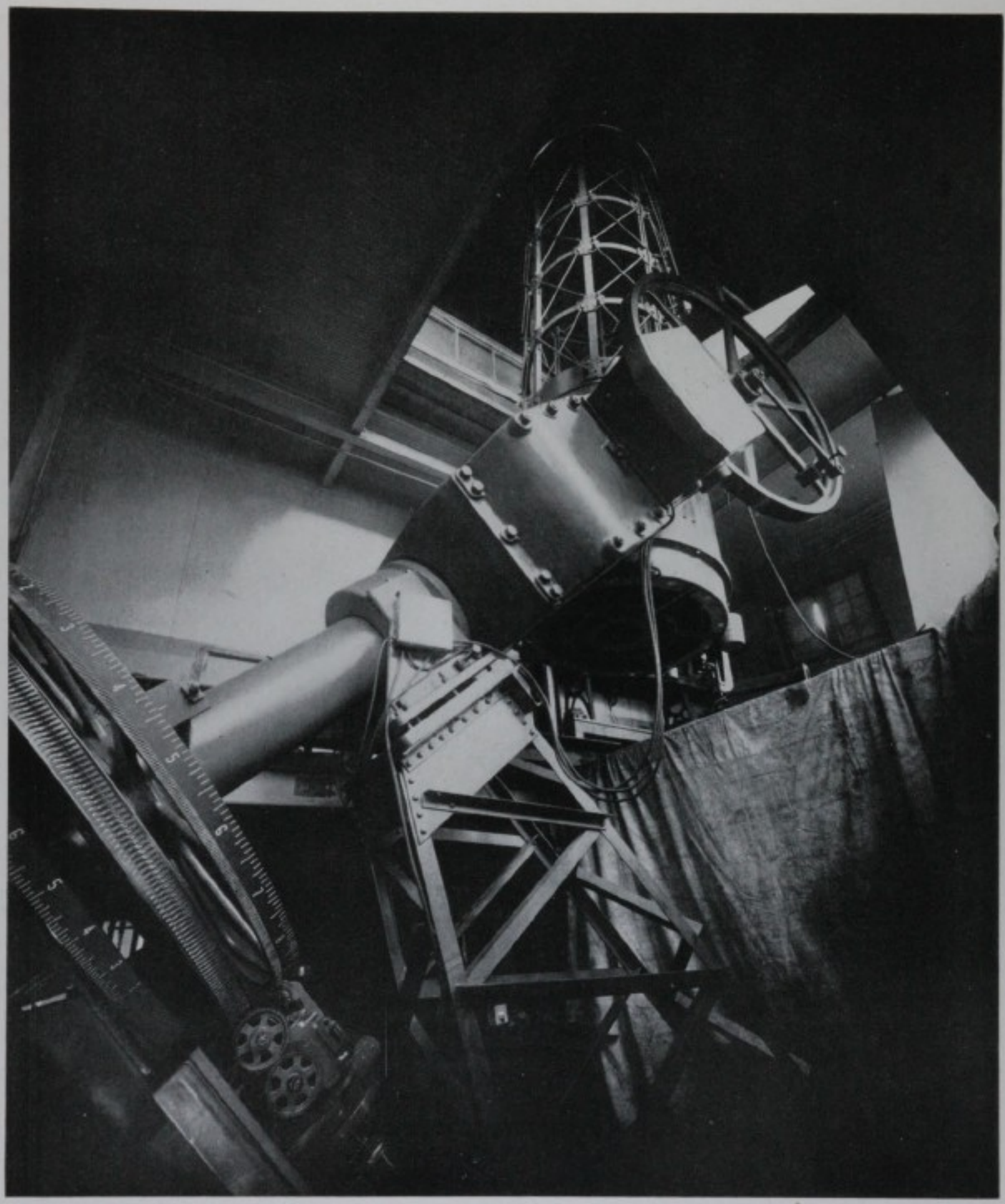
Indiana's New Observatory and Planetarium

The Remarkable Variable Al Velorum

American Astronomers Report

Experiments Concerning Lunar Formations

Northern and Southern Star Charts



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Sky and TELESCOPE

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# June Eclipse Observers Partly Successful

OVERCAST skies defeated most observers stationed in the path of totality of the June 20, 1955, eclipse of the sun. Only a few expeditions were able to carry out their plans, according to early reports.

To observers this eclipse was a tantalizing gamble. Astronomers were attracted by the unusually long duration of totality, which even reached 7 minutes 7.8 seconds at one point in the China Sea. Nowhere, however, were the weather prospects favorable. The path of totality, as may be seen in the map on page 142 of the February, 1955, issue, was largely over oceans. The narrow zone of totality did cross Ceylon, Thailand, Indo-China, and the Philippines, but June in these countries occurs in the rainy season when skies are generally overcast.

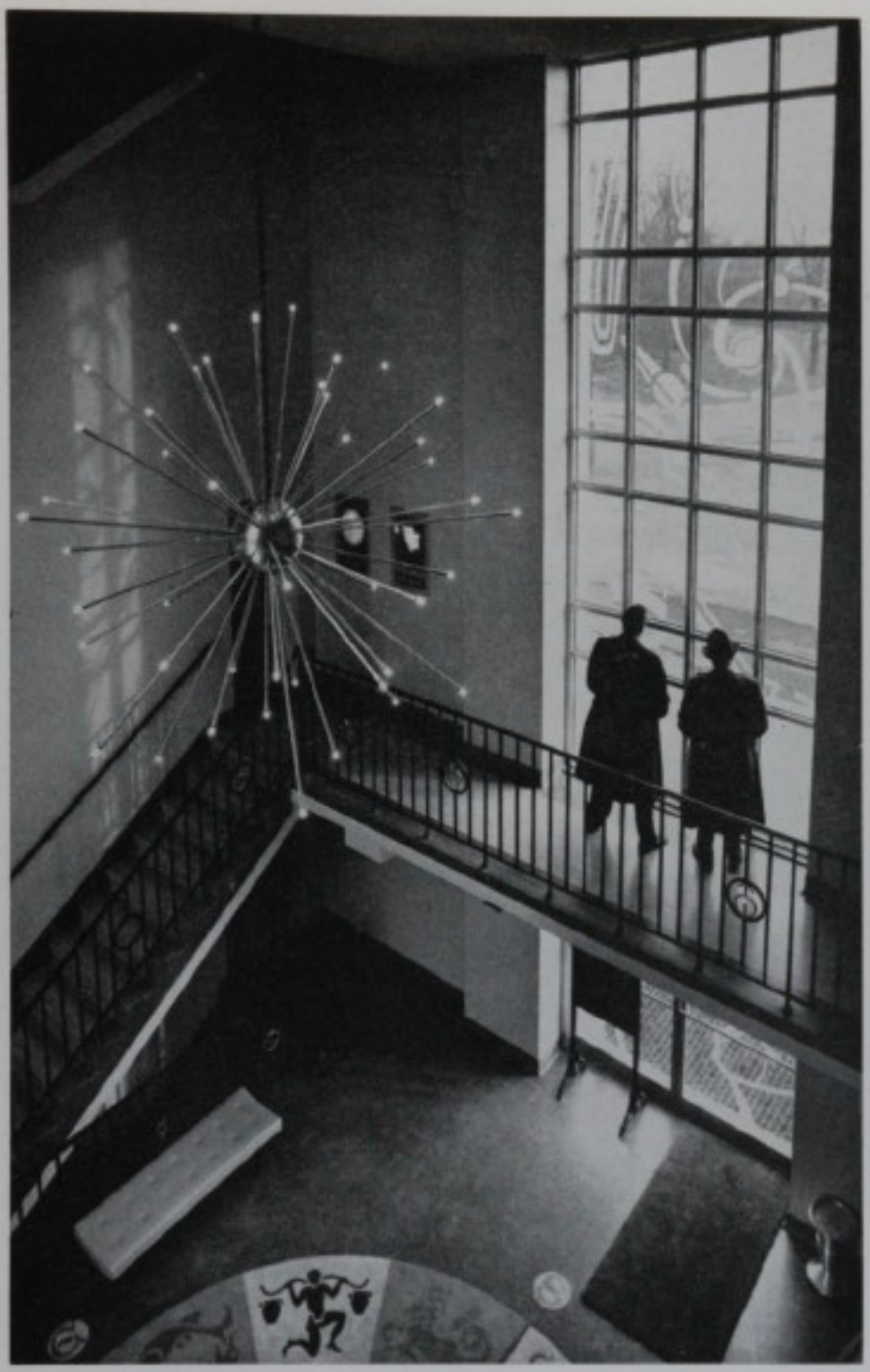
Most observers chose eastern Ceylon for their expedition sites, as the mountains in the center of the island offered shelter from the southwest monsoon. This strategy enabled the Harvard Observatory party at Sigiriya to achieve some success. Although at this place thin clouds covered the sun during totality, it was possible to secure records of the infrared spectrum of the corona. The sky was not good enough to carry out the plans for measurement of the brightness of the corona, which were outlined on page 263 of the May issue.

Other eclipse observers in Ceylon were less fortunate. At Hingurakgoda, Dr. H. von Klueber, of Cambridge Observatory, England, had erected 15 tons of equipment to measure the Einstein effect—the deflection of starlight passing near the sun's edge. During totality, however, a black cloud covered the region of the sun. At this same station there were also Dutch, French, and Indian astronomers. Dr. A. K. Das, who led the Indian party, reported that radio and ionospheric programs were successful, but optical observations could not be carried out.

The weather was also cloudy for the Japanese and Swiss at Polonnaruwa, Ceylon. After the eclipse the disappointed Swiss astronomers flew their national flag at half-mast.

In the Philippine Islands the sky was only partly cloudy. Contrary to general expectations, observing conditions turned out to be more favorable, on the whole, than in Ceylon. Photographs of the corona secured at Manila showed the marked equatorial extension which is usual in years when sunspots are few in number.

*(Continued on page 406)*



# Indiana's New Observatory and Planetarium

HARRY E. CRULL, *Director*
*J. I. Holcomb Observatory and Planetarium*

**A view from the north balcony indicates some of the many ways that astronomical motifs were used in the decoration of the main lobby, and shows how the lower part of the south window looks from inside. Photographs on these two pages are by the "Indianapolis Star Magazine."**

ON THE CAMPUS of Butler University in Indianapolis, there is a new observatory that houses the largest telescope in the state of Indiana and probably the largest in the United States intended primarily for public instruction. In addition, the building has a Spitz planetarium in one wing and a spacious lecture room in another.

The building is open free to the public on Saturday and Sunday afternoons and evenings throughout the year, except on holidays and during Christmas vacation. There are four scheduled planetarium shows during these hours for which an admission charge of 50 cents is made (student tickets are 25 cents). The facilities are available for special groups on three afternoons and evenings; school groups may make special reservations four mornings a week. University classes in all fields may use the building as part of their course of instruction. Thus, the J. I. Holcomb Observatory and Planetarium is carrying on a full schedule of astronomical education for the public.

The 50-foot central tower is surmounted by the observatory dome, as shown in the front-cover picture. The building is 110 feet long and 30 feet wide, its exterior finished in "shot-swan" Indiana limestone. The main lobby is housed in the tower section. Reaching from the threshold to the ceiling level of the telescope room 36 feet above are two windows 7½ feet wide. Into their heat-resistant glass, A. G. Wolter sandblasted two unique artistic interpretations of astronomical subjects. One of these windows is in the south face of the lobby (seen on the front cover) and the other in the north. The designs are lighted at night for exterior viewing, and may be seen clearly from the inside as well. Drapes cover the upper part of the windows so their illumination does not light the telescope dome room. Stairways lead upward to the dome room, past the director's office and a darkroom.

The dome room is 28 feet square, with a concrete slab ceiling in which a 24-foot circular opening is cut for the dome. The square form of the room, with the necessity for headroom in the corners, raises the mounting of the telescope about three feet above the floor line, but there is nearly an 80-per-cent gain in floor space. A higher observing platform results, but its two-way stairs expedites the flow of observers. There are benches around the room.

The telescope is mounted on a concrete slab containing 21 cubic yards of reinforced concrete; the slab is in turn supported on four 18-inch square legs of concrete and I-beam construction placed in the walls, one on each side of the north and south windows. The entire mount is free of contact with the building at any point above the foundation. This construction eliminated the conventional pier under the instrument and permits unrestricted use of the main lobby.

Constructed by J. W. Fecker, Inc., the instrument is a 38-inch Cassegrainian reflector with an effective focal length of 576 inches, designed for visual or photographic use. The mirror perforation is nine inches in diameter. The Cassegrainian focus is being used exclusively at present. The guide telescope, a 6-inch refractor, is the reconditioned former occupant of the university observatory on the old Irvington campus of many years ago. An IBM electric 24-

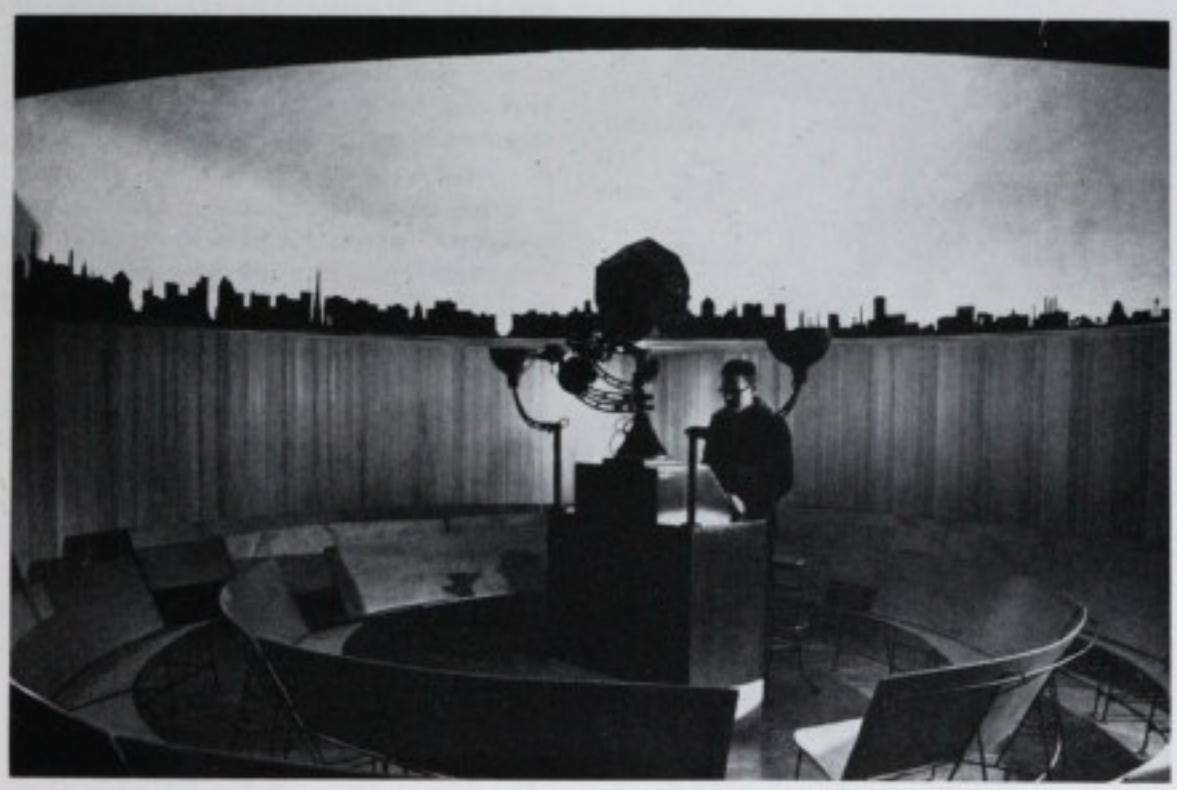
hour clock, an electric sidereal clock, and a time-signal radio are located in the dome room.

Laminated wood bent to a 12-foot radius was used for the ribs of the dome, which is of wood construction covered with aluminum-impregnated plastic similar to that used by the U. S. Navy for the "mothball fleet." Twelve steel wheels mounted on the ceiling slab bear the circular rail attached to the lower plate of the dome. Three Holcomb and Hoke stoker motor and drive units turn the dome. The slit is of the "up-and-over" type, in two sections, the lower covering 30 degrees of altitude; it provides a windscreen when objects high in the sky are being observed.

The main lobby incorporates many astronomical motifs, including 20 large transparencies of celestial objects. The terrazzo floor contains a 14-foot circular representation of the zodiac in nine colors, surrounding a rayed disk for the sun. The railings on the stairways and balconies are wrought iron with a series of cast brass symbols of the sun, moon, and planets in succession.

Access to the planetarium wing is from the lobby down a short flight of steps into a clock exhibit room. The light level is diminished here, to begin the eye adaptation necessary for the planetarium itself, and next two light-block vestibules lower the light level further. The floor of the planetarium wing is four feet below the level of the rest of the building, in order to fit the 12-foot-radius planetarium dome into the exterior dimensions. The 28-foot-square chamber seats 100 persons, on circular benches. The dome surface is acoustic plaster painted with white textolite, giving 60 per cent sound absorption and 70 per cent light reflection. The skyline is painted in flat black with the chief landmarks and buildings of Indianapolis, but not as seen from any particular point. Ducts from the heater and air-conditioner are scarcely noticeable in the black of the skyline.

**Dr. Crull stands on the observing platform of the 38-inch Cassegrainian reflector in the Holcomb Observatory. Part of the very thick cement slab that forms the ceiling of the telescope room and that also carries the track for the revolving dome may be seen.**



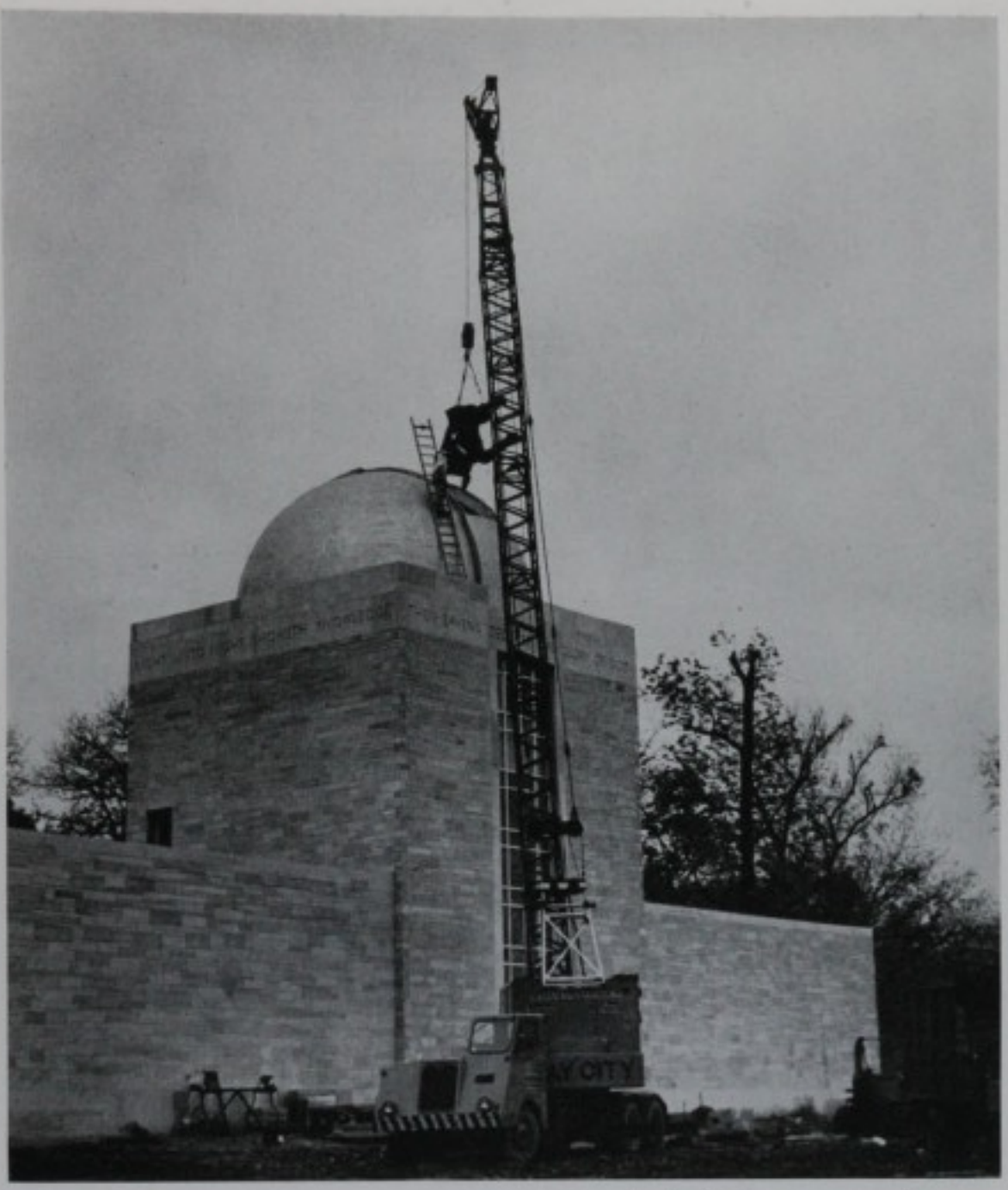
**The west wing houses a Spitz model A-1 planetarium projector and seats 100 persons on circular benches made by Spitz Laboratories.**

In the east wing, the lecture hall can seat 125 persons or accommodate a class of about 40 using tables, or the room may be cleared for exhibit space. A public address and high-fidelity sound system can carry either announcements or music throughout the building.

The entire cost of the project, about $350,000, has been borne by Mr. and Mrs. James Irving Holcomb, of Indianapolis. The building was designed and constructed in 18 months under the direction of Arthur Lindberg, superintendent of building and grounds at Butler University.

The observatory staff is at present working on projectors for the planetarium constellation figures and on an earth projector for the moon lecture.

From its formal opening on November 5th (*Sky and Telescope*, December, 1954, page 61) up to June 1st the observatory



**A long construction crane was necessary, after the building was erected, to carry the telescope parts to the dome more than 50 feet above the ground. Here the yoke of the instrument is being lowered through the dome opening. The main tube of the Fecker-made telescope was brought in this same way. Photograph by H. H. Houghtalen.**

had been visited by more than 21,000 people, about half of whom attended a planetarium demonstration. Last semester the school program proved so popular that reservations at one time ran six weeks ahead, and by May 1st the school schedule was filled. Numerous clubs and organizations have taken advantage of the facilities of the building, and the response to the public programs has been fine.

With increased incidence of clear weather in the summer and autumn, attendance should continue at even higher levels. We look forward to continuing public service and to an increasing public interest in astronomy.

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### *BRIGHTNESS AND COLOR OF MARS*

During the 1954 opposition of Mars, Dr. H. L. Johnson and A. J. Gardiner measured the planet's brightness and color photoelectrically on 21 nights from April 23rd to July 15th at Lowell Observatory. The brightness varies with the distances of the planet from earth and sun, and with phase. Allowing for these effects, the authors find a residual variation of about 0.1 magnitude, due to the rotation of the planet. When longitude 300° on Mars faces the earth, the planet is brightest and reddest.

After correction for the purely geometrical effects, a decrease in brightness of 0.015 magnitude was found for each degree increase in phase angle—the angle at Mars between the sun and the earth. This value agrees well with earlier determinations by G. Mueller and E. S. King, also in yellow light. The effect depends in a complicated manner upon the nature of the atmosphere and surface material of the planet, and should eventually give new information concerning them.

The Lowell astronomers' investigation is reported in the *Publications* of the Astronomical Society of the Pacific for April, 1955.

### *JUNE ECLIPSE OBSERVERS PARTLY SUCCESSFUL*

*(Continued from page 403)*

The most favored of observers in the Philippines was Dr. Frank Back, of New York, whose preparations for air observations enabled him to watch totality for 11 minutes. Thanks to the co-operation of the U. S. Air Force, he observed from a T-33 jet trainer which flew at 600 miles per hour along the track of totality, in the same direction that the moon's shadow was moving. In this way he could keep the corona in view four minutes longer than could observers on the ground. According to press reports, Dr. Back obtained seven spectrograms of the corona. This means of stretching out the valuable minutes of totality should prove useful at coming eclipses, if equipment does not require rigid support by fixed piers.

The over-all picture, as judged from early field reports, is largely one of failure from adverse weather on June 20th. However, the value of this eclipse to astronomy cannot be told until after the long analysis is completed of the observations that could be made.

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### *SUSPECTED SUPERNOVA FOUND IN BOOTES*

The true nature of an object discovered on May 16th by Dr. H. Haffner, at the Bergedorf Observatory, Germany, has not been fully explained. It was first reported as a 14th-magnitude supernova at the north end of a faint uncatalogued galaxy in right ascension $15^h\ 14^m.2$, declination $+25°\ 13'$ (1950).

G. Abell and P. Wild, of Mount Wilson and Palomar Observatories, report an observation with the 100-inch reflector on May 28, 1955. In the location described by Haffner they found a condensation that was not stellar in appearance, but which displayed a more complicated structure with at least two bright portions.

They have also identified this condensation on plates taken with the 48-inch Palomar Schmidt telescope on April 19, 1950, where the feature is of magnitude 16 or 17. At Heidelberg Observatory, Dr. K. Reinmuth found no indication of the condensation on a photograph taken June 5, 1942, with the 16-inch refractor.

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### ECLIPSE OF THE MOON

*The full moon faded. In its place I saw*
*The glowing ghost of my old agate taw,*
*And wished that I might keep it until dawn*
*And plump the round red marble of the sun.*

WALTER W. STEPHEN

# The Remarkable Variable AI Velorum

OTTO STRUVE, *Leuschner Observatory, University of California*

I SHALL always remember the variable star AI Velorum. George Herbig and I observed it in 1948 with the Cassegrain spectrograph of the McDonald Observatory, and the experience was the most exhausting one in my life as an observing astronomer. This 8th-magnitude star is located at 44° south declination, and it therefore reaches a meridian altitude of only 16 degrees at the McDonald Observatory.

The 82-inch reflecting telescope was designed to reach a declination of 51° south, because we wanted to observe Canopus with our high-dispersion coude spectrograph. But AI Velorum has a period of 2 hours 40 minutes, and Dr. Herbig wanted to cover two cycles in a single night. Hence, the telescope was almost horizontal at the beginning and end of the night's run, and the observer had to climb below the tube, or through it, in order to reach the spectrograph.

Moreover, the camera extended almost six feet beyond the edge of the observing platform, and even the guiding eyepiece was well outside the normal reach of the observer. Fortunately, both of us are tall, and we were therefore able, with considerable exertion, to reach the controls at the eyepiece and the plateholder.

The variability in the brightness of AI Velorum had been discovered by E. Hertzsprung in 1931 from direct photographs obtained by H. van Gent with the Franklin-Adams camera at Johannesburg in South Africa. He found the period to be 161 minutes, or very nearly one ninth of a day—the shortest period but one on record at that time. A few years later F. Zagar and H. van Hoof independently measured two additional series of van Gent's photographs and established the fact that the range of the light fluctuations is variable: A cycle having a range of nearly one magnitude may be followed by one of only 1/10 magnitude.

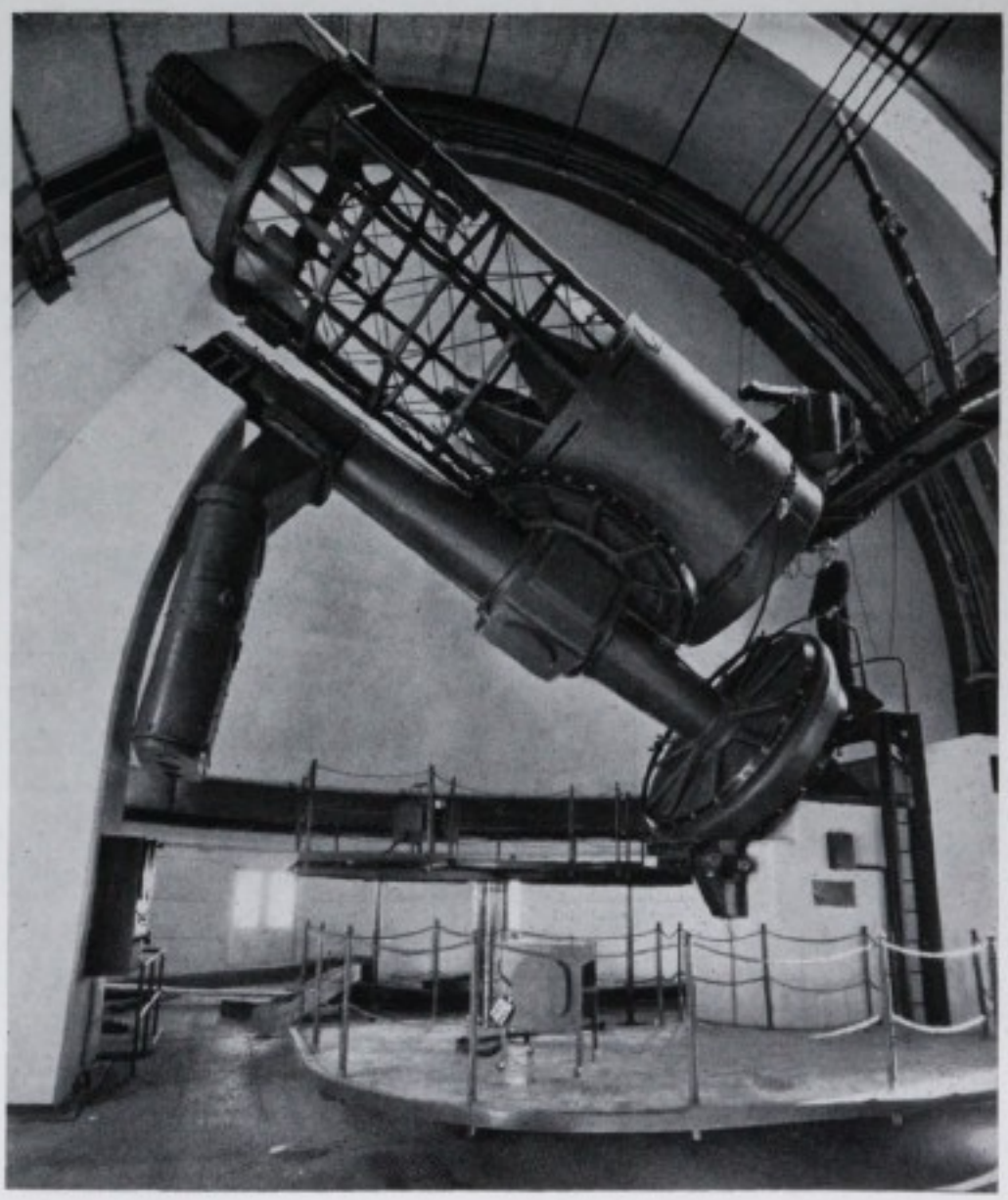
The McDonald spectrograms were measured by Dr. Herbig, and he found the variation of velocity in the line of sight—the radial velocity—to have the same period that Hertzsprung found for the light changes of the star. But the range in radial velocity is itself variable, sometimes as much as 44 kilometers per second during one cycle, sometimes zero; the mean radial velocity of the star is about +15 kilometers per second. Although there were no simultaneous photoelectric observations, it was reasonable to believe that the range in velocity is correlated with the range in brightness.

Herbig also found that when the range in radial velocity is large, the spectral type of the star varies between *A*4 at minimum radial velocity and *F*2 at maximum radial velocity. When the range in velocity is small, the spectral class remains nearly constant, about *A*8 or *F*0. Changes of spectral type during the light fluctuation are, of course, normally observed in pulsating stars.

Quite recently, important new work has been done by several investigators of AI Velorum. A fine study has been published by T. Walraven, who observed this variable photoelectrically with the 16-inch refractor of the Leiden station at Johannesburg. Spectrographic observations have been made by L. Gratton and C. J. Lavagnino, of the La Plata (now Eva Peron) Observatory, who used the 60-inch reflector at the Bosque Alegre station of the Cordoba Observatory in Argentina.

Walraven's work is particularly impressive. He observed with a specially designed photometer that directly recorded on a tracing the difference in magnitude between the variable and the comparison star. No time was lost setting the telescope back and forth between the two objects. He observed in 1951, "and during three months in 1952 and five months in 1953 "every clear moment, even between passing clouds," and he accumulated a stupendous amount of material.

Perhaps Walraven even benefited by the fact that the sky in Leiden is rarely suitable for photoelectric work so that,



**The 82-inch McDonald Observatory reflector of the University of Texas is located on Mt. Locke. The observing platform is in the background.**

**The variable star AI Velorum is marked by two short lines. The two very bright stars are Zeta Puppis, above, and Gamma Velorum. Two fine open star clusters mark this part of the southern Milky Way: NGC 2477 in the upper right, and NGC 2547 near the middle of the lower edge. North is above on this enlargement of part of a Boyden station patrol plate taken March 12-13, 1951, a two-hour exposure on a blue emulsion with a 3-inch camera of 21 inches focal length. Harvard Observatory photograph.**

after his return to Holland, he was able to discuss his observations exhaustively. It is no exaggeration to say that his article, "The Pulsations of AI Velorum, SX Phoenicis and RR Lyrae," in the February 12, 1955, *Bulletin* of the Astronomical Institutes of the Netherlands, represents the most detailed and informative discussion ever made of the properties of any variable star.

Sample records of Walraven's observations of AI Velorum are shown in Fig. 1. The irregularity in the fluctuations is evident; sometimes the change in brightness is nearly a full magnitude, at other times only a fraction of this. In his analysis, Walraven seeks to explain this and other peculiar characteristics of the light curve.

First, there appear to be two conspicuous interfering pulsations: the primary one discovered by Hertzsprung, $P_0$ = 161 minutes, with a "corrected" range of 0.34 magnitude in blue light; and the secondary one, $P_1$ = 124 minutes, range 0.22 magnitude. Walraven assumes that the gases in the deeper layers of the photosphere of AI Velorum vibrate with two harmonic oscillations having the periods $P_0$ and $P_1$. These combine to produce a beat period of 546 minutes or nine hours. When the oscillations reinforce each other the total range in brightness is 0.53 magnitude; when they interfere the range is 0.13 magnitude.

The two oscillations are shown as sine curves in A at the top of Fig. 2, and the result of combining them as curve B. This curve already begins to resemble the observed light curves of Fig. 1. But the latter sometimes have a range of nearly a magnitude, and they are always steeper on their ascending branches and less steep on their descending branches. These discrepancies are explained by Walraven on the assumption of two effects that he calls S and M distortions of the light curve.

Part C of Fig. 2 illustrates the S distortion. The dotted curve in C is the same as curve B, and the solid curve in C is produced as follows: Each point is displaced toward the left if above the central line and to the right if below it, the amounts of the displacements being proportional to the distance of each point from the central line. The new curve is very nearly the mirror image of the radial-velocity curve observed by Gratton (Fig. 3). It is still symmetrical with respect to the central line.

But the observed light curve shows large variations in the heights of the maxima of AI Velorum and only moderate changes in the minima. (This, incidentally, is a general property of many pulsating stars, such as SX Phoenicis and Delta Scuti.) Hence, Walraven introduces the M distortion. All points above the central line are raised by amounts that change with the distance of each point from the central line. All points below the central line are also raised, but by smaller amounts. The dotted curve in D of Fig. 2 is the same as the continuous curve in C. The unbroken curve in D is the resulting light curve, which now resembles the observations in a fairly satisfactory manner.

Walraven noticed two additional small periodicities in the residuals he obtained

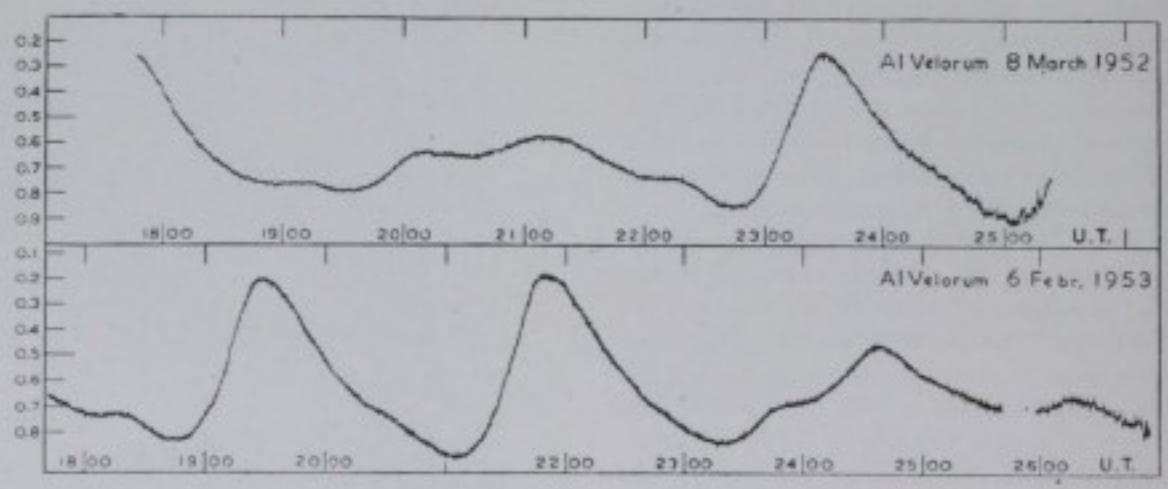



**Fig. 1. Brightness changes of AI Velorum, observed photoelectrically by T. Walraven. The vertical scale is difference in magnitude from the comparison star; the horizontal time scales are carried past 24 hours to avoid change of date. Note how the tracings at the right become ragged, because of poorer seeing as the star sank low in the west.**

by subtracting curve D from the observed light curve. The effect of these periodicities can be seen directly in the upper panel of Fig. 1 between 19 and 23 hours; the fluctuation there has a cycle of about one hour. Walraven finds that these small changes correspond to two interfering periods, $P_2$ = 64 minutes and $P_3$ = 46 minutes, with ranges 0.04 and 0.01 magnitude, respectively. The beat period of $P_2$ and $P_3$ is 161 minutes—exactly equal to $P_0$, a most remarkable and unexpected result.

But this is not all. The Dutch astronomer finds still another period, $P_1'$ = 132 minutes, almost but not quite the same as the 124 minutes of $P_1$. This last period has a range of 0.02 magnitude.

How can we explain all these complicated periodicities? Walraven reminds us of a hypothesis advanced by J. Woltjer in 1935 and more recently exploited by M. Schwarzschild. Like an organ pipe, a star can vibrate not only in its fundamental mode but also in various overtones. For a star built on a certain reasonable model, and having a fundamental period of 161 minutes, the first overtone would have a period of 70 minutes and the second overtone would be 46 minutes. In AI Velorum the first overtone has not been found, although Walraven has searched for it. The second overtone is his period $P_3$.

According to Woltjer, the fundamental mode and one of its higher modes may interact to produce a new oscillation whose frequency is the difference of the frequencies of the interacting modes. In the case of AI Velorum, the 161-minute principal oscillation would interact with the undiscovered first overtone of 70 minutes to give a new oscillation with the observed period $P_1$ of 124 minutes. The same principal oscillation would interact with the second overtone to produce $P_2$ of 64 minutes. Finally, the first overtone of 70 minutes and the second overtone of 46 minutes would produce $P_1'$ of 132 minutes.

Walraven remarks, "The mechanism responsible for the coupling is not known," and points out that the absence of the first overtone in AI Velorum is unexplained. He concludes, "The only justification for [use of Woltjer's hypothesis] is that so far there is no alternative explanation. Without this hypothesis every observed oscillation in AI Velorum becomes a problem of its own."

The physical causes of the S and M distortions are still somewhat obscure. But it is significant that the velocity curve obtained by Gratton shows the S distortion (the descending branches are always steeper than the ascending branches, as in Fig. 3), but not the M distortion. In the absence of the latter, the velocity curves are symmetrical about a horizontal line drawn through the mean value of the velocity of the star. AI Velorum is receding relative to the sun, and its average Doppler shift is +15 kilometers per second.

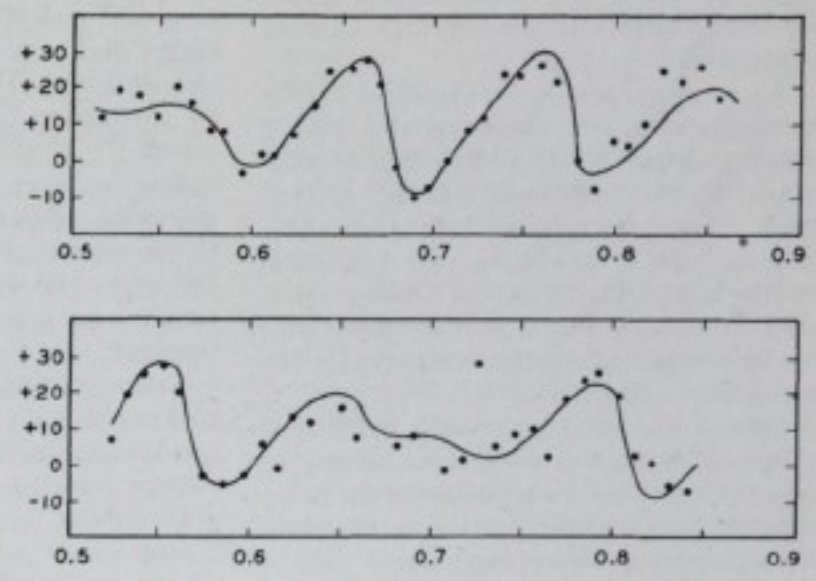



**Fig. 3. Radial-velocity observations of AI Velorum by L. Gratton and C. J. Lavagnino, on January 20 and 24, 1950. Ordinates are in kilometers per second; abscissae represent fractions of a day. The solid curve is computed from two superimposed periodicities. All diagrams with this article are adapted from the "Bulletin" of the Astronomical Institutes of the Netherlands.**

Assume that some layers of gas deep in the star's atmosphere oscillate outward and inward, as harmonic pulsations. As the resulting wave travels outward it becomes observable in the outer layers of the star, and the radial velocities indicate directly the speed of the gas at each moment. But like any wave of appreciable amplitude traveling in a homogeneous medium, it becomes more and more distorted and loses its initially symmetrical, sine-curve shape. Much like a sea wave near the point of breaking, the leading side becomes steeper and the following side flattened. This phenomenon is of a fundamental nature and affects both the velocity curve and the light curve.

But the brightness of the star is a rather complicated function of the temperature and density of the oscillating gas layer. The light changes need not reproduce the actual motion, back and forth, except for the period. Walraven has, in fact, shown that the light emission from the oscillating layer should increase much more when the oscillations combine to give a large velocity of expansion than when they combine to give rapid contraction.

Curious as the behavior of AI Velorum is, this variable star is not unique. Other variables, though less well studied, show similar traits, and next month we shall examine how these objects are related to the more familiar types of stars.

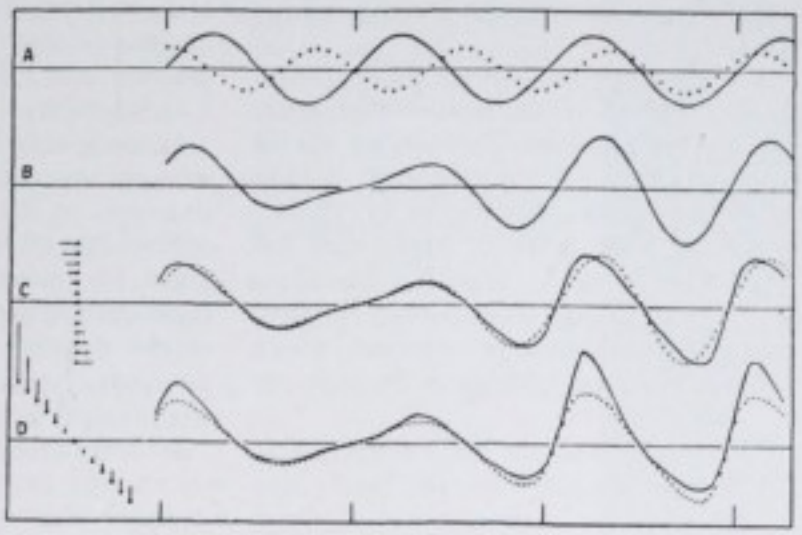



**Fig. 2. Synthesis of the light curve of AI Velorum, which is explained in the text on the facing page. The short lines in C show the S distortion; in D they indicate the M distortion.**

## *HIGH-ALTITUDE RESEARCH STATIONS*

There are at least twoscore high-altitude research stations in the world where work is done on cosmic rays, astronomy, meteorology, glaciology, biology, and other sciences. Data on these stations have been compiled by a joint commission of the International Council of Scientific Unions. Edited by Dr. Serge A. Korff, New York University, the compilation has been published with the aid of funds from UNESCO and the National Science Foundation. Dr. Korff has personally visited a large number of the stations in connection with his own cosmic ray researches.

The compilation, consisting of questionnaires filled in by the station supervisors, lists the geographical and geomagnetic locations of each station, climatic conditions, accessibility, housing, and research facilities. In many cases these last are most primitive, in some as elaborate as a modern ski resort.

Most of the stations are at altitudes of 7,500 feet or higher, the highest being the Chacaltaya cosmic ray laboratory in Bolivia, at 18,000 feet. The most northerly is on the summit of Mt. Wrangell in Alaska, and the most southerly is Argentina's cosmic ray station in the Antarctic. The United States has at least seven stations, but none is listed for Russia, as no questionnaires from that country were returned.

# Amateur Astronomers

## Three Regional Conventions Held in May and June

### NORTH CENTRAL REGION

THE NINTH annual convention of the North Central Region of the Astronomical League was held at the Adler Planetarium in Chicago on May 13-14. Hosts were the Burnham Astronomical Society, the Burnham Juniors, the Chicago Astronomical Society, and the Adler Planetarium. The roll call of societies revealed that 126 persons had registered from 10 societies in five states, a record attendance for a North Central convention.

An informal session was held on Friday evening, with the main activity taking place on Saturday. Two Milwaukee amateurs, Roy L. Dodd and Edward A. Halbach, gave descriptions of their 1954 eclipse trips to Michigan and Labrador, respectively. Lunch at the Chicago Natural History Museum was coupled with an inspection of the museum's extensive meteorite collection.

One of the most interesting features of the convention was the junior session, at which six papers were presented by members of three societies. Later in the afternoon, sunspots were extensively treated by Ralph N. Buckstaff, AAVSO member from Oshkosh, Wis., and Terry Schmidt, of Elgin, Ill. Other highlights were a description of tests made on a Schmidt mirror, by Albert V. Shatzel, Adler Planetarium, and an informative presentation on "The Spectrum and Astronomy," by Jack Barker, Chicago.

The banquet was attended by 84 persons, who heard Dr. Dean B. McLaughlin, University of Michigan Observatory, describe his new theory of volcanic activity to explain the dark markings on Mars. After the banquet, open house was held at the Dearborn Observatory of Northwestern University in nearby Evanston. Perfect skies enabled observing through the famous 18½-inch Clark refractor.

New officers for the region were elected as follows: chairman, Mr. Dodd; vice-chairman, H. B. Porterfield, Madison, Wis.; secretary-treasurer, Mrs. Ralph N. Buckstaff, Oshkosh; regional representative, Robert G. Johnsson, Chicago.

JOSEPH A. ANDERER
7929 S. Loomis Blvd.
Chicago 20, Ill.

### MID-STATES REGION

NEARLY 100 persons attended the sixth annual convention of the Astronomical League's Mid-States Region, held in the Kansas City (Mo.) Museum, May 28-30. The Astronomy Club of Kansas City was host. Members were also present from region societies at Fayette, Mo., Little Rock, Ark., St. Louis, Mo., and Wichita, Kans. Only the Tulsa Astronomical Society was not represented.

Dr. G. Van Biesbroeck, Yerkes Observatory, spoke on "Star Systems." Other professional astronomers attending included Dr. N. Wyman Storer and Prof. Henry Horak, University of Kansas, Lawrence, and Dr. Floyd F. Helton, Central College, Fayette.

Dr. Joseph Shipman, director of the Linda Hall Scientific Library in Kansas City, gave a talk on "Rare Books on Astronomy and Other Sciences." He displayed books published nearly 500 years ago dealing with principles propounded by Aristotle, Euclid, Archimedes, and others.

The weather permitted two evening observing sessions with telescopes made by members of the Kansas City club. Delegates also viewed a display of instruments and saw motion pictures on astronomy.

Among the talks were three on meteors, concerned with meteoric dust, meteoric astronomy, and the determination of meteor velocities by radio methods, given respectively by Walter S. Houston, St. Louis, Earl Cook, Kansas City, and Fred Hartman, Kansas City. "The Null Test on an f/6 16¾-inch Paraboloid" was discussed by Stan Warkoczewski, Kansas City.

The convention re-elected as 1955-56 Mid-States officers: chairman, Robert E. Follett, Kansas City; vice-chairman, James Boyd, St. Louis; secretary and treasurer, Mr. and Mrs. John A. Stuart, Tulsa. Joseph A. Smith, Kansas City, continues as Mid-States representative to the general council of the Astronomical League.

Fayette will be the site of our 1956 regional convention.

LAURA KINSEY
4604 Jefferson St.
Kansas City 12, Mo.

### SOUTHWEST REGION

WITH A REGISTRATION of 102, and some 30 or 40 visitors, the League's Southwest Region, including Texas, New Mexico, and Louisiana, held a successful convention in Dallas on June 17-18.

The meeting started on Friday afternoon at Southern Methodist University with several sessions, the setting up of exhibits, and a get-together. That evening, Oscar E. Monnig, of Ft. Worth, spoke on "The Story of Meteorites Recovered in Texas." Harrison Sarrafian, 15-year-old junior astronomer, demonstrated his homemade planetarium, which shows more than 1,000 stars through the 4th magnitude.

Color movies of the 1954 eclipse were shown on Saturday by Dr. and Mrs. Orland Baker, who observed at St. Paul, Minn. The junior session included a number of papers and demonstrations, with about a score of junior astronomers participating. A panel of experts, with Dr. H. C. Sehested as moderator, rounded out the evening program.

On Sunday, those registered at the convention were admitted to the Dallas Planetarium for its current show, "From Galileo to Palomar."

At the business meeting, the following were re-elected to regional office: Ted F. Gangl, chairman; James M. McMillen, secretary-treasurer; Miss Charlie M. Noble, chairman of junior activities. Newly elected were Walter H. Haas, vice-chairman, and the undersigned, regional representative.

E. M. BREWER
5218 Morningside Ave.
Dallas 6, Tex.

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### HIGHLIGHTS AT YOSEMITE

At the seventh annual convention of Western Amateur Astronomers, to be held in Yosemite National Park August 19-21, the National Bureau of Standards will exhibit a portable radio telescope. This will be demonstrated by Vernon A. Goerke, leader of the bureau's solar radio astronomy project at Boulder, Colo.

Among the convention speakers will be Dr. Gerald E. Kron, Lick Observatory, on photoelectric photometry, and Dr. Oliver J. Lee, director emeritus of Dearborn Observatory, who will show his motion picture on astronomy, Looking Through Great Telescopes.

Further plans for the convention were published here in February and June. Reservations for accommodations should be made at once with the Convention Dept., Yosemite Park and Curry Co., Yosemite National Park, Calif.

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### VARIABLE STAR OBSERVERS MEET IN PITTSBURGH

THE 44th spring meeting of the American Association of Variable Star Observers was held May 27-29, at the Buhl Planetarium, Pittsburgh, Pa.

Flare stars were the main topic of interest and discussion, stimulated by a detailed and historical account of them given by Dr. N. E. Wagman, director of Allegheny Observatory. Recorder Margaret W. Mayall supplemented Dr. Wagman's talk with an outline of the present and future programs of the AAVSO for flare stars. Gunnar Darsenius, a variable star observer in Sweden, sent a paper on his observations of stars of this type.

Mrs. Mayall told of a specialized program for observers using photoelectric photometers; and Harry Bondy, chairman of the AAVSO Solar Division, reported on participation in the International Geophysical Year.

Robert Adams commented on visual observing, in particular his work on peculiar stars such as V Sagittae, his

search for novae, and the possible variability of certain comparison stars. He found that outlining the AAVSO charts on the Skalnate Pleso atlas is a great help in locating and identifying the stars. George Diedrich, the new chairman of the nova search committee, announced his plans for enlarging its program.

The late Leon Campbell's long-awaited study of long-period variables will soon be published. Edited by Mrs. Mayall, it will contain mean light curves and dates of maxima and minima of nearly 400 variables.

The program of the meeting included an open house at Allegheny Observatory, featuring Dr. Keivin Burns' demonstrations with his spectroscopes, and a visit to the optical shop of J. W. Fecker, Inc., where astronomical instruments and manufacturing methods were shown.

The AAVSO fall meeting will be on October 21-22 at the Museum of Natural History in Springfield, Mass.

R. NEWTON MAYALL
45 Bromfield St.
Boston 8, Mass.

## SIZES OF TELESCOPES AMONG CHICAGO AMATEURS

In a telescope census of its adult members, the Burnham Astronomical Society (now the Chicago Astronomical Society) in Chicago, Ill., found that reflectors outnumbered refractors more than three to one. Of a total of 93 instruments, one was a 6½-inch Schmidt camera, one a 10½-inch refractor, and one a 16-inch reflector.

Ten of the refractors ranged in size from 1-inch to 2½-inch, and 10 from 3-inch to 4-inch. Among the reflectors, 15 were 3½-inch, 25 were 6-inch, and 12 were 8-inch. In the range from 10 to 12½ inches, there were seven reflectors.

## TELESCOPE MAKERS TO GATHER IN VERMONT

The 1955 Stellafane meeting is to be on Saturday, August 20th, at Springfield, Vt., under the joint sponsorship of the Springfield Telescope Makers and the Amateur Telescope Makers of Boston. Dr. Charles A. Smiley, of Ladd Observatory, fresh from his solar eclipse expedition to Bangkok, will act as master of ceremonies. The judging committee will be headed by honorary chairman Albert G. Ingalls, with John W. Lovely and Samuel M. Gardiner as co-chairmen.

Telescopes and special exhibits will be judged in the afternoon for construction, mountings, and design, and in the evening for over-all performance. New designs and classics are equally welcome. The early evening will feature informal talks, and observing will follow, for which everyone is urged to bring an instrument.

A conducted tour of the Jones and Lamson plant's optical comparator division is scheduled for 1:30 p.m.

*(Continued on page 419)*

## CONVENTION AT LOUISVILLE

On Labor Day weekend the Louisville Astronomical Society, host to the Middle East regional convention at that time, will dedicate the Moore Observatory. The dedication will take place Sunday afternoon, September 4th, following a picnic at the home of Dr. W. L. Moore, of the University of Louisville. That evening there will be observing with the new 21-inch reflector.

Headquarters for the convention will be the Baptist Theological Seminary, 2825 Lexington Rd., where registration will open Friday evening and the business and other sessions will begin on Saturday at 9:30 a.m. The first session on Sunday will be at 1:30 p.m., to be held at the Miller Observatory atop the natural science building on the University of Louisville campus. A meeting Monday morning will close the convention.

The registration fee is $1.00 until August 1st and $1.50 thereafter. Dormitory rooms on the seminary campus are $2.00 each, and family apartments accommodating up to four persons are $5.00. Cafeteria meals will be available. Registration and reservation should be sent to Mrs. Virginia C. Lipphard, 2421 Calvin, Louisville, Ky., with checks payable to Richard Holsbog, convention treasurer.

WILBUR D. JOHNSON
3911 S. 2nd St.
Louisville 14, Ky.

## ALLYN J. THOMPSON DIES

AFTER a lengthy illness, Allyn Joseph Thompson, an amateur telescope maker of long standing, died at his home in New York City on June 12, 1955.

Following the construction of his first telescope about 19 years ago, Mr. Thompson joined the Optical Division of the Amateur Astronomers Association on May 4, 1939. From 1942 to 1948, he was an instructor in the popular mirror-making classes conducted at the Hayden Planetarium, and he was on the board of directors of the AAA from 1945 until 1954.

Born on February 8, 1901, he attended Cooper Union and Pratt Institute, where he studied art. For 10 or 15 years in his youth, he was a semiprofessional baseball pitcher. In 1921, he began to work for the post office system in New York City, rising to superintendent of the Parkchester post office in the Bronx. He was assistant superintendent at the Grand Central post office until a serious automobile accident in 1952, followed by an operation for cancer, forced his retirement.

The series of articles by Mr. Thompson that ran monthly in *Sky and Telescope* from November, 1944, through October, 1945, entitled "Making Your Own Telescope from Start to Finish," was the basis for his full-sized book, *Making Your Own Telescope*. More than 13,500 copies have been printed since the book first appeared in 1947. His interest in art was valuable in preparing many of the book's illustrations.

All of Mr. Thompson's work in telescope making was characterized by attention to detail and willingness to experiment and to investigate new ideas. As a result of his contributions to the hobby of amateur astronomy, Mr. Thompson enjoyed a world-wide correspondence with fellow telescope makers.

**Allyn J. Thompson is seen here with the prototype of the instrument whose construction is described in "Making Your Own Telescope." This design has become very popular among amateurs. The photograph was taken in the basement of the Hayden Planetarium in New York City, where the Optical Division has its workshop.**

# AMERICAN ASTRONOMERS REPORT

*Here are highlights of some papers presented at the 92nd meeting of the American Astronomical Society at Princeton, N. J., in April. Complete abstracts will appear in the* Astronomical Journal.

**Ultraviolet Solar Spectrum**

Since 1946 it has been possible to observe from rockets the ultraviolet spectrum of the sun at wave lengths shorter than 2900 angstroms, a spectral region masked from ground observers by the earth's atmosphere. Much new information has been gained from spectrograms taken on February 21, 1955, at altitudes up to 125 kilometers in an Aerobee rocket fired at White Sands Proving Ground, N. M. During the entire flight, an automatic control kept the spectrograph pointed accurately at the sun.

The records have been analyzed by F. S. Johnson, H. H. Malitson, J. D. Purcell, and R. Tousey, of the Naval Research Laboratory. As the rocket passed over the peak of its trajectory, a spectrum with an exposure of 30 seconds was obtained. The continuous spectrum of the sun extended to wave lengths as short as about 1550 angstroms, and absorption lines were visible to about 1680 angstroms.

Far in the ultraviolet, from 1817 to 977 angstroms, over 30 bright (emission) lines have been identified, representing nine elements in the sun's atmosphere. Previously, only three emission features had been observed in the rocket ultraviolet solar spectrum: the Lyman-alpha line of hydrogen, and emission cores of two strong magnesium lines.

The emission lines appear of equal intensity at the center and edge of the sun's disk. This is in marked contrast to the appearance of absorption lines in the region of longer wave length, where the effect of limb darkening is conspicuous in the spectrograms.

**Alpha Capricornid Meteors**

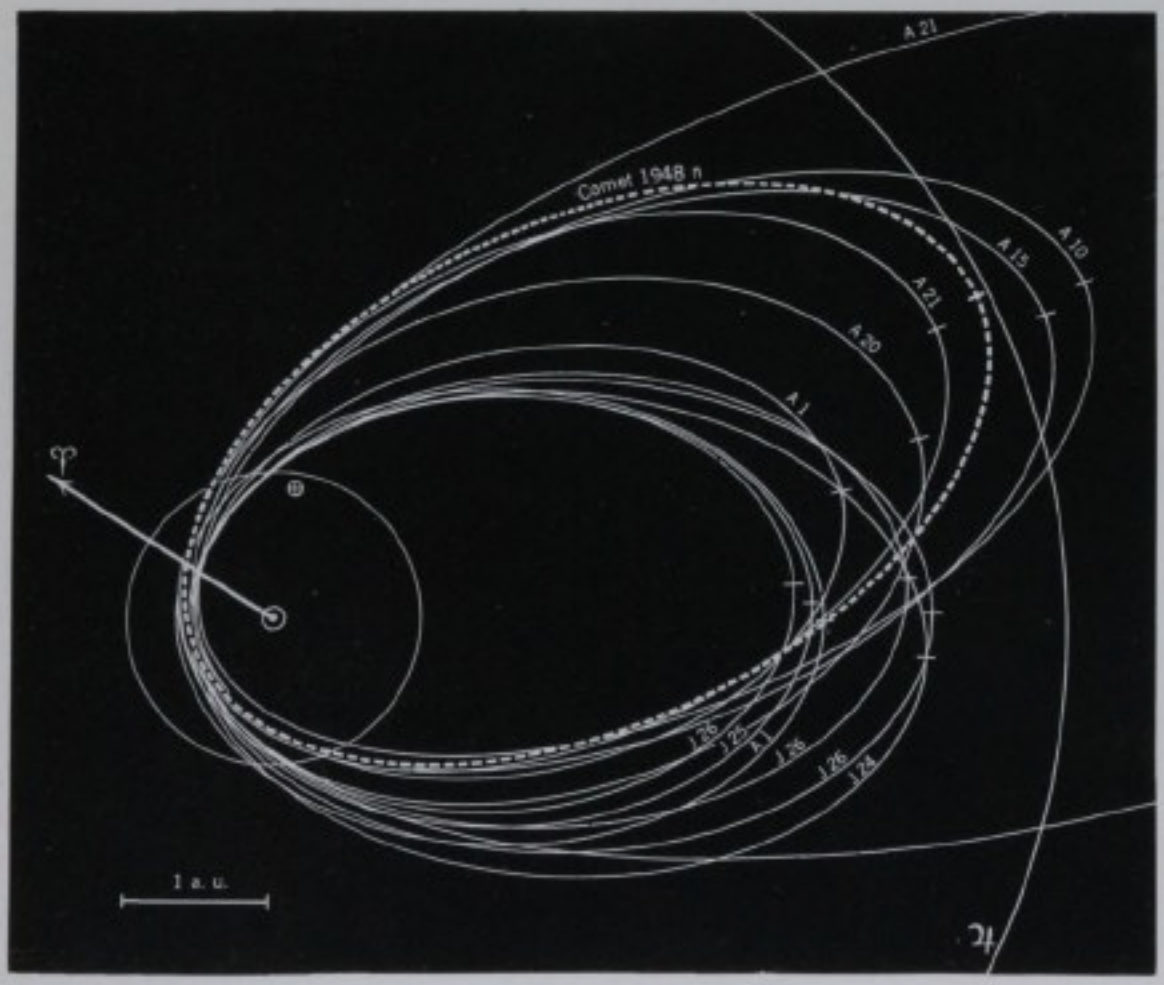
Each year between July 16th and August 22nd occur the sparse Alpha Capricornid meteors. An analysis of the shower has been made at Harvard Observatory by Frances W. Wright, L. G. Jacchia, and F. L. Whipple. They have studied the radiant points and orbits of 12 meteors that were each photographed from two stations, as well as 50 single-station meteors.

The results suggest strongly that the July and August Alpha Capricornids form two distinct meteor streams, with orbital periods of 3.64 and 5.02 years, respectively. The 12 double-station orbits in the diagram are drawn on the plane of the ecliptic without correction for foreshortening. It is evident that the aphelion points are well within Jupiter's orbit for the July stream, and close to Jupiter's orbit for the August stream, without much continuity between the two.

The July stream has an inclination to the ecliptic of seven degrees; the August group averages 0.6 degree. Comet 1948n, shown by the dashed orbit in the diagram, has a period of five years and an inclination of about 13 degrees. This comet, one of the brightest in recent years, thus appears to be a possible parent of the later Alpha Capricornids, which have a longitude of perihelion of 53°, quite close to 57°, the longitude of perihelion for Comet 1948n.

In fact, examination of a few accurate orbits for the Iota Aquarid meteor shower, along with values for velocities, proves that Comet 1948n is definitely not associated with the latter stream, as Rigollet had proposed from less accurate orbits. The Iota Aquarid meteors travel more rapidly than Rigollet thought.

The new work also shows that the Alpha Capricornids cannot be related to either of the two parent comets previously suggested by other investigators: Comet 1881 V and 1457 II. The Harvard astronomers stated, however, that a unique cometary origin for the Alpha Capricornids is doubtful—that the shower may be impure.




**The orbits of 12 Alpha Capricornid meteors are drawn here, as computed from Harvard photographic observations. The 1¼-inch circle at the left is the earth's orbit, and part of Jupiter's orbit appears at the right. Note the marked differences between the July (J) and August (A) orbits, indicating that these meteors are probably a mixture of at least two streams.**

**Variable Rotation of the Earth**

It has been known for over a decade that the rate of the earth's rotation undergoes a very small change in a one-year period. This has been examined by Dr. William Markowitz, U. S. Naval Observatory, from time determinations made with the photographic zenith tubes at Washington, D. C., and Richmond, Fla., from September, 1951, to October, 1954. During this period, observations were made on more than 200 nights per year at Washington and on over 300 nights per year at Richmond.

The observations of stars with the zenith tubes indicate time as influenced by any alterations in the rotation period of the earth. The alterations can be detected by comparison with a time-keeper that is independent of the earth's rotation, in this case, two quartz-crystal clocks of the National Bureau of Standards. The precision of these clocks is so high that neither deviated from the average by as much as 0.002 second over the entire three years.

The variation in the earth's rotation was fairly regular from year to year. On October 1st the earth was about

0.035 second fast, and on June 1st about 0.035 second slow. Further analysis showed a one-year period of 0.030-second amplitude, and superimposed on this a half-year period of 0.010-second amplitude. The one-year term, apparently, is due principally to meteorological causes, as had been known before.

In addition, tides affect the moment of inertia of the earth and hence the length of the day. The half-year term is principally due to a solar tide. Two other tidal terms in the earth's rotation, with periods of 13.6 and 27.6 days, were also found by Dr. Markowitz. They have amplitudes of about 0.001 second each, and their existence had been predicted by Y. Mintz and W. Munk.

### Magellanic Cloud Distances

At the Commonwealth Observatory, Mt. Stromlo, Australia, a new determination of the distance of the Magellanic Clouds has been made by Drs. W. Buscombe and G. de Vaucouleurs, from 10 novae observed in these nearby southern galaxies. They assume, on the basis of earlier work, that both clouds are at the same distance.

The method is based on the fact that if the light curves of Milky Way novae are plotted on an absolute magnitude scale, the novae that are brighter at maximum fade more rapidly. The Mt. Stromlo astronomers find that for 11 galactic novae the light curves intersect 14 days after maximum, at absolute magnitude −5.2.

For novae in the Magellanic Clouds, the corresponding intersection of the light curves of fast and slow novae is at apparent magnitude +13.4. Hence the distance modulus of the clouds is 18.6 magnitudes, corresponding to a distance of about 170,000 light-years. As this figure does not allow for dimming by interstellar dust, the true distance is somewhat less. The result then agrees well with earlier estimates by other methods. The resemblances between galactic and Magellanic Cloud novae appear to warrant confidence in the new method.

### Rho Ophiuchi Dark Nebula

Information about the internal structure of dark nebulae is needed for studies of their evolution and of their connection with star formation. The great complex of obscuring matter surrounding the star Rho Ophiuchi is a promising object for detailed investigation, because of its size and nearness. Dr. Bart J. Bok, of Harvard Observatory, reported on his analysis of this nebula, based upon star counts on photographs taken with the Palomar 48-inch Schmidt telescope.

The main body of this great dust cloud lies directly south of Rho Ophiuchi, and is a roughly spherical concentration of dust about 10 parsecs in diameter. According to T. A. Matthews, its distance from the sun is about 200 parsecs. On plates obtained in blue light, stars as faint as magnitude 20.0 were counted. Near the center of the obscuration, the total dimming of background stars runs as high as eight magnitudes, diminishing to 1.5 magnitudes near the edges of the main body of the cloud.

From the dimming, Dr. Bok could determine the density of material in the nebula, on the assumption that the dust grains are all of the size that would scatter blue light most effectively. On this basis, the average density in the main body of the nebula is about 0.05 solar mass per cubic parsec. This is about 30 times the average for the entire Ophiuchus complex, and about 300 times the average in the Milky Way near the galactic plane. At the center of the Rho Ophiuchi nebula, the density is about one solar mass for five cubic parsecs, and the total mass involved in the main body of the cloud is probably over 30 times the mass of the sun. Dr. Bok pointed out that the actual densities and masses may be even higher, if the dust grains are not all of the same size.

**The inner part of the vast Rho Ophiuchi dark nebula, studied by Bart J. Bok, is nearly central in this photograph. The rich star field in the lower left would extend over the entire picture were this great obscuring cloud absent. Rho Ophiuchi itself, near the top (north) illuminates part of the cloud. Antares is at the lower left, with the large globular cluster M4 to its right; between and above them is another globular, NGC 6144.**

### Fragmentation of Meteors

At Harvard Observatory, Dr. L. G. Jacchia has extended his study of the slowing down of meteors as they plunge into the earth's atmosphere. He had already found that anomalously large increases in the deceleration of faint photographic meteors are due to their progressive fragmentation. There is much evidence that meteor bodies are extremely fragile; for example, many of the meteors photographed with the super-Schmidt cameras in New Mexico seem to be completely disrupted and travel as clusters of fragments over most of their visible paths.

Dr. Jacchia has now studied the extent of fragmentation for meteoric bodies of different sizes and brightnesses. A "fragmentation index," based on the observed deceleration of the meteor, is used to describe the rate at which fragmentation proceeds. This index number is nearly zero for big fireballs (in which only a small fraction of the main body is lost by disruption), increases rapidly for fainter meteors, reaches a maximum for meteors of visual magnitude +1 to

+2, and seems to drop off before the working limit of the super-Schmidt cameras, about magnitude +3 to +4, is reached.

From this and other evidence, it appears that the faintest meteors recorded on photographic films show a maximum of fragmentation, but that a lower size limit for fragments is being approached, so that further disintegration becomes more difficult. If confirmed, this may mean that for very small radio meteors and for micrometeors drastic breakup does not occur.

### Observations of Planetaries

One of the most remarkable of the known planetary nebulae is 10th-magnitude NGC 7027 in Cygnus, located at right ascension $21^h\ 05^m.1$, $+42°\ 02'$ (1950). This object has the richest bright-line spectrum of all gaseous nebulae, and it has a higher surface brightness than any other planetary. Since the central star of NGC 7027 makes no direct contribution to the spectrum, this star must be so hot that most of its radiation is ultraviolet; its temperature evidently exceeds 150,000° K.

The spectrum of NGC 7027 has been studied in detail by Drs. I. S. Bowen and R. Minkowski, Mount Wilson and Palomar Observatories, and Dr. L. H. Aller, University of Michigan Observatory. They used the coude spectrograph of the 200-inch telescope for the identification of the nebular lines. Probably every line observable in any planetary is represented in NGC 7027. Lines from no fewer than 40 different ions have been identified, covering a large range in excitation from that of neutral nitrogen to iron ionized six times. Most of these identifications check those made in 1939 and 1942 by Bowen and A. B. Wyse.

For measuring the intensities of the bright lines, spectrograms with the 100-inch Mount Wilson and the 82-inch McDonald reflectors were also obtained. Thus, this study of NGC 7027 involved co-operative work with the world's three largest operating telescopes.

Dr. Aller has also been working with Dr. W. Liller, of Michigan, on photoelectric photometry of planetaries. For 122 of these nebulae, they have measured the surface brightness through a narrow-band interference filter that isolated the green oxygen line at 5007 angstroms. The Curtis Schmidt telescope at Portage Lake, Mich., was used for observing extended objects of low surface brightness, such as the Owl and Dumbbell nebulae. Nearly 100 faint planetaries, and a few gaseous nebulae in the galaxy in Triangulum, M33, were added with the Mount Wilson 60- and 100-inch reflectors.

## Planetarium Notes

*(Most planetariums give group and special showings by appointment.)*

BALTIMORE: *Davis Planetarium.* Maryland Academy of Sciences, Enoch Pratt Library Building, 400 Cathedral St., Baltimore 1, Md., Mulberry 2370.

SCHEDULE: 3:45 p.m. Monday and Friday (Sept.-June); Thursday, 7:15, 7:45, 9:00 p.m. Admission free. Spitz projector. Director, Paul S. Watson.

BUFFALO: *Buffalo Museum of Science Planetarium.* Humboldt Parkway, Buffalo, N. Y., GR-4100.

SCHEDULE: Sunday, 2:00 to 4:30 p.m. Admission free. Spitz projector.

CHAPEL HILL: *Morehead Planetarium.* Univ. of North Carolina, Chapel Hill, N.C.

SCHEDULE: Daily at 8:30 p.m.; also 11 a.m. and 3 p.m. Saturdays, 3 and 4 p.m. Sundays. Zeiss projector. Manager, A. F. Jenzano.

CHARLESTON, W. VA.: *Hillis Townsend Planetarium.* Public Library Building, Charleston, W. Va.

SCHEDULE: Saturday, 11:15 a.m. Admission free. Spitz projector. Director, Louise L. Morlang.

CHEROKEE, IA.: *Sanford Museum Planetarium.* Sanford Museum, 117 E. Willow St., Cherokee, Ia.

SCHEDULE: Monday, 8 p.m. (except August). Admission free. Spitz projector. Director, W. D. Frankforter.

CHICAGO: *Adler Planetarium.* 900 E. Achsah Bond Drive, Chicago 5, Ill., Wabash 2-1428.

SCHEDULE: Mondays through Saturdays, 11 a.m. and 3 p.m.; Tuesdays and Fridays, 8 p.m.; Sundays, 2 and 3:30 p.m. Zeiss projector. Director, Wagner Schlesinger.

DALLAS: *Dallas Planetarium.* Dallas Museum of Fine Arts, State Fair Park, Dallas, Tex., LO-5663.

SCHEDULE: Saturday, 11 a.m.; Sunday, 3 and 4 p.m. Spitz projector.

FT. WORTH: *Charlie M. Noble Planetarium.* Ft. Worth Children's Museum, 1501 Montgomery St., Ft. Worth, Tex., PA-1461.

SCHEDULE: Tuesday and Thursday, 4 p.m.; Saturday, 10:30, 11:30, 2, and 3; Sunday, 2, 3, and 4 p.m. Spitz projector.

INDIANAPOLIS: *Holcomb Planetarium.* Butler University, Indianapolis 7, Ind.

SCHEDULE: Saturday and Sunday, 4 and 8 p.m. Spitz projector. Director, Harry E. Crull.

KANSAS CITY: *Kansas City Museum Planetarium.* 3218 Gladstone Blvd., Kansas City 23, Mo., Humboldt 8000.

SCHEDULE: Saturday, 3:00 p.m.; 2nd and 3rd Sundays, 3:00 and 4:30 p.m. Spitz projector. Director, Kenneth W. Prescott.

LAQUEY, MO.: *Tarbell Planetarium.* Inca Cave Park, Laquey, Mo.

SCHEDULE: Daily, 1 to 6 p.m., continuous. Spitz projector. Director, E. D. Tarbell.

LOS ANGELES: *Griffith Observatory and Planetarium.* Griffith Park, P. O. Box 27787, Los Feliz Station, Los Angeles 27, Calif., Normandy 4-1191.

SCHEDULE: Wednesday, Thursday, and Friday at 8:30 p.m.; Saturday and Sunday at 3 and 8:30 p.m.; extra show on Sunday at 4:15 p.m. Zeiss projector. Director, Dinsmore Alter.

MINNEAPOLIS: *Science Museum.* Minneapolis Public Library, 1001 Hennepin Ave., Minneapolis 3, Minn.

SCHEDULE: Tuesday, 7:30 p.m.; Saturday, 10 a.m. and 2 p.m. Admission free. Spitz projector. Curator of education, Maxine L. Begin.

NASHVILLE: *Sudekum Planetarium.* Children's Museum, 724 2nd Ave. S., Nashville 10, Tenn., 42-1858.

SCHEDULE: Sunday, 2:45, 3:30, 4:15. Spitz projector. Associate curator of education, Burton Ingram.

NEWARK: *Newark Museum Planetarium.* 49 Washington St., Newark 1, N. J., Mitchell 2-0011.

SCHEDULE: Saturday and Sunday, 2:30 and 3:30 p.m. Admission free. Spitz projector. In charge, Ray Stein.

NEW YORK CITY: *American Museum—Hayden Planetarium.* 81st St. and Central Park West, New York 24, N. Y., Trafalgar 3-1300.

SCHEDULE: Mondays through Fridays, 2, 3:30, and 8:30 p.m.; Saturdays, 11 a.m., 1, 2, 3, 4, 5, and 8:30 p.m.; Sundays and holidays, 1, 2, 3, 4, 5, and 8:30 p.m.; Mondays, Wednesdays, Thursdays and Fridays, 11 a.m., for school groups. Zeiss projector. General manager, J. M. Chamberlain.

PHILADELPHIA: *Fels Planetarium.* Franklin Institute, 20th St. at Benjamin Franklin Parkway, Philadelphia 3, Pa., Locust 4-3600.

SCHEDULE: Tuesdays through Sundays, 3 p.m.; Saturdays, 11 a.m.; Saturdays, Sundays, and holidays, 2 p.m.; Wednesdays, Fridays, and Saturdays, 8:30 p.m. Zeiss projector. Director, I. M. Levitt.

PITTSBURGH: *Buhl Planetarium and Institute of Popular Science.* Federal and West Ohio Sts., Pittsburgh 12, Pa., Fairfax 1-4300.

SCHEDULE: Mondays through Saturdays, 2:15 and 8:30 p.m.; Sundays and holidays, 2:15, 4:15 and 8:30 p.m. Zeiss projector. Director, Arthur L. Draper.

PORTLAND, ORE.: *Oregon Museum of Science and Industry Planetarium.* 908 N.E. Hassalo St., Portland 12, Ore., East 3807.

SCHEDULE: Saturday and Sunday, 3:00 p.m. Spitz projector. Director, Stanley H. Shirk.

PROVIDENCE: *Roger Williams Planetarium.* Roger Williams Park Museum, Providence 5, R. I., Williams 1-5640.

SCHEDULE: Saturdays, Sundays, and holidays, 3 and 4 p.m. Admission free. Spitz projector. Director, Maribelle Cormack.

SAN FRANCISCO: *Morrison Planetarium.* California Academy of Sciences, Golden Gate Park, San Francisco 18, Calif., Bayview 1-5100.

SCHEDULE: Daily (except Monday and Tuesday) at 3:30 and 8:15 p.m.; also at 2 p.m. on Saturdays, Sundays, and holidays. Academy projector. Curator, George W. Bunton.

SPRINGFIELD, MASS.: *Seymour Planetarium.* Museum of Natural History, Springfield 5, Mass.

SCHEDULE: Tuesdays, Thursdays, and Saturdays at 3 p.m.; Tuesday evenings at 8:30 p.m.; special star stories for children on Saturdays at 2 p.m. Admission free. Korkosz projector. Director, F. Korkosz.

STAMFORD: *Stamford Museum Planetarium.* Courtland Park, Stamford, Conn.

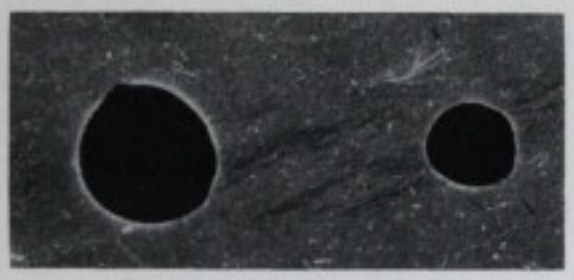
SCHEDULE: Sunday at 4:00 p.m. Admission free. Spitz projector. Director, Ernest T. Luhde.

# Experiments Concerning Lunar Formations

INGOLF RUUD, *Oslo, Norway*

IN A NUMBER of technical papers published from 1928 to 1952,* I have advanced and presented evidence in support of a *theory of direct contraction,* applicable to the development of ring mountains on the moon and some major geological features on the earth. Here I will give an elementary outline of this proposal, and will describe simple experiments to illustrate its application to lunar craters.

The main line of reasoning is that the ring mountains on the moon were produced by deformation of the moon's crust as it contracted on cooling. As is well known, it may be computed that for a globe the size of the earth or moon a crust 100 kilometers thick will cool considerably from radiation into space over periods of the order of a thousand million years. The interior, on the other hand, is so well insulated that its temperature will remain nearly unchanged over such intervals, if convection does not occur. As the crust cools, it contracts and tightens about the interior, and deformations will occur that would be comparatively simple for the moon, but on earth they would be greatly complicated by erosion and sedimentation occurring at the same time.



**Holes produced in gutta percha when it is subjected to horizontal stretching in all directions.**

This hypothesis is called the theory of direct contraction to contrast it with the usual contraction theory. According to the latter, mountain formation on the earth is attributed to the crust becoming too big as the earth's interior decreases in volume—somewhat as the skin of a drying apple wrinkles.

I have used several types of experiment to simulate the deformation processes in the lunar crust, which is regarded as subject to continually increasing stretching in all horizontal directions. When layers of plastic materials, such as gutta percha or pitch, are stretched in this way, with the aid of a specially constructed tension apparatus, the result is always the same—growing circular holes form from points of weakness that happen to exist in the material.

However, the earth's crust, and probably also the moon's, does not consist of a single layer but roughly speaking of two layers which intrude into one another. The lower layer is the thicker; it cools off, contracts, and becomes plastically deformed. The thinner upper layer will have already cooled off, and therefore it does not contract, but it is deformed by the lower layer. Under these conditions, the crust will tend to be deformed in circular areas, where there will be decreasing thickness of the lower plastic layer, whereas the outer layer will be displaced radially and pressed together to form a ring-shaped swelling around the circular area.

A simple experiment will illustrate. Glue or gelatin is dissolved in a little boiling water to give a solution with a specific gravity of about 1.1. This is poured on a plate of glass, and a plastic layer of increasing thickness will form on the surface of the glue. In this layer, as it cools and contracts, formations resembling ring mountains will slowly develop—first quite small, later larger ones up to two centimeters in diameter. These features show a number of analogies to the craters on the moon.

Similar phenomena are shown by a second experiment. A partly inflated rubber bladder is coated on its upper half with a plastic material and then is further inflated. This produces deformations in the plastic layer that resemble the lunar surface. A soccer-ball bladder is suitable, and another bladder can serve as a compressed air container. While almost any pastelike material can be used for the plastic layer, ordinary putty is perhaps best, as its consistency can be varied with a little linseed oil.

**The formations that result from the contraction of a cooling layer of glue resemble some of the lunar features. Rings like those shown here range up to three quarters of an inch across in the author's experiments.**

This experiment involves expansion of the layer, instead of contraction. However, an expansion will produce just the same kinds of tensions and deformations as a prevented contraction, such as my theory stipulates for the crusts of the earth and moon.

The results of the second experiment

**The author's explanation of the formation of a ring mountain by the direct contraction theory. The lower layer (hatched) deforms and thins in a circular area; the outer layer is displaced radially to form a raised rim around this area.**

*For example, *Zeitschrift fuer Astrophysik, 8,* 295-343, 1934; *Gerlands Beitraege zur Geophysik, 52,* 123-169, 1938; *Avhandlinger,* Norske Videnskaps-Akademi i Oslo, Matematisk-naturvidenskapelig Klasse, 1949, No. 2 (28 pages, in English).

will depend on the consistency and thickness of the layer, and the extent and speed of the deformation. If the material applied has little fluidity, the expansion will cause only cracks; very fluid material, on the other hand, will not undergo visible deformation. The production of "ring mountains" corresponds to an intermediate case.

The surfaces formed in this way have, as can be seen from the photographs, several general points of resemblance to real lunar scenery, but also several points of dissimilarity. The "ring mountains" vary from pronounced rings to poorly developed formations, the latter reminiscent of the ruined or "sunken" craters in some areas of the moon. There is also a tendency for pairs of ring mountains or twin craters to form. If the material has a suitable consistency, strings of craterlets occur, and sometimes short curved mountain arcs and isolated peaks.

But the craters in the bladder experiment have little or no difference in the level of their interior floors compared with the surrounding surface, and they never have a central cone. In the latter respect they resemble the smaller rather than the larger of the actual lunar craters. The model craters do not overlap, nor are they surrounded by systems of bright rays. These discrepancies, I believe, result from carrying out the experiment with a single plastic layer, from which the moon's crust differs in several ways. Presumably it has become deeper and thicker during the long interval in which the lunar craters were probably formed; the crust encloses the whole moon; and the crustal contraction takes place at a depth, not at the surface.

Now it is often assumed that the smallest lunar ring mountains are the youngest, for two reasons: In hundreds of cases, small craters appear to break into larger ones, but never conversely, and the small craters look more perfect and hence younger than large craters. But the first reason fits rather with a volcanic or meteoritic explanation of the lunar surface, and the second implies improbable erosion on the moon.

On the direct contraction theory, however, the small ring mountains are the oldest, as a consequence of the moon's crust having become progressively thicker. The smaller craters would still be intact, on this theory, because they were already part of the stiff surface masses when the younger, larger, deeper-lying ring mountains were formed. In the gelatin experiments, the smallest, oldest rings interrupt the larger ones. The second experiment does not show the effect, for in it the plastic layer is homogeneous.

Since the moon's crust completely encloses its interior, the horizontal tension forces in the crust will produce a corresponding pressure on the inner mass. This may break up the inside of a crater to form a central mountain. Such an effect can sometimes be noted in the first experiment.

Experience shows that during the deformation of plastic materials there often appear lines of flow on the surface. Both theory and experiment indicate, in the case of a surface being stretched away from a point, that the lines of flow will be radial from that point. Along these lines the material will be either compressed or broken up. This process may well have produced the conspicuous rays that diverge from some particularly well-developed craters, such as Tycho. When vitreous substances are crushed, their albedo is greatly increased, and perhaps this may be true of the lunar surface materials.

According to my theory, the ring mountains are not related to the volcanoes on the earth or to its relatively very small meteorite craters, but they are related to the earth's mountain chains. There is a similarity in shape and arrangement between the moon's great arcs of mountains around some of the largest maria and the mountains ringing the Pacific Ocean.

If it is thought that the model experiments I have described here may really be related to the formation of the moon's ring mountains, it would be interesting to continue the experiments on a larger scale, using more than one layer, either homogeneous or not, and with varied materials for the "crust."

**The bladder experiment for simulating lunar surface features.**

**Typical features produced with the soccer-ball equipment are shown here, illustrating the effect of different consistencies of the plastic layer. The reduction from the original model is about 4 to 3.**

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**FACING PICTURE: The southern part of the last-quarter moon along the terminator (boundary between lunar day and night) contains some of the most striking of lunar scenery. In the upper right is Clavius, largest of the ringed plains on the moon. It is nearly as big as West Virginia. The crater Tycho, with its prominent central peak, is easily identified at right center. In this picture can be found examples of ruined formations, craters with interior craterlets, strings of craters, and overlapping rings. Lick Observatory photograph.**

# NEWS NOTES

By Dorrit Hoffleit

### *ILL WIND AT METEOR CRATER*

A few years ago a new museum building was constructed on the edge of Meteor Crater in Arizona. On May 31st this year, unusually high winds blowing northward from the Mogollon Plateau to the Painted Desert wrecked the museum. D. Moreau Barringer, president of the Barringer Crater Company, writes:

"I have seen this wind attain a 50- or 60-mile velocity, but this must have been a good deal higher than that. The wind was so strong that the police had closed Highway 66 that day, and there were no tourists in the building. George Foster, the curator, was in a hospital in Winslow recovering from an operation. His wife was in the building and managed to escape without a scratch.

"The ranch superintendent was outside in the parking lot, trying to keep a trailer from being blown over, when the roof of the building came off and sailed over his head and lit on the road below the parking place, completely blocking traffic for a couple of days. All the windows and doors blew in at about the same time, and finally a considerable section of the stone wall collapsed. I am told they managed to save 80 per cent of the exhibits and merchandise in the building.

"The catastrophe was not as great as might have been, for we have been working all winter on plans for altering and enlarging the building. We are deeply thankful that no one was injured; only about 10 days of operation were lost, and Meteor Crater is open to visitors again."

### *25th ANNIVERSARY AT THE ADLER PLANETARIUM*

The Adler Planetarium, first to open in America, celebrated its 25th anniversary on June 9th. The principal speaker was Dr. Harold Urey, whose topic was "Man and His Conception of the Universe." Director Wagner Schlesinger gave a planetarium demonstration. Other speakers included the mayor of Chicago, the president of the Chicago Park District, and Robert Adler, son of the donor, Max Adler, who died in 1953.

The exercises had been planned for May 11th, exactly a quarter century from the original date of opening. The delay was incurred in waiting for completion of a new perforated-aluminum dome which replaces the original one of painted linen. Other improvements, not all of them completed to date, include a new sound system, theater seats, a new switchboard, air conditioning, and an up-to-date Chicago skyline.

Final renovations will probably not be concluded before the end of 1956. Half of their $265,000 cost comes from public funds, the rest from the Adler Planetarium trust fund, which was to have been used to replace the original Zeiss projector, in case this should become necessary during the first 25 years, but the instrument shows no signs of wearing out. The fund was set up by Max Adler from admissions received during the Century of Progress Exposition in 1933 and 1934.

### *FRENCH SOLAR FURNACE*

A solar furnace that has operated for the past two years high in the Pyrenees Mountains has just received a United States patent. It consists of two large mirrors, one a parabola with an area of 105 square yards, made up of several hundred small mirrors of pliable glass. Mechanical stresses applied to the small thin mirrors help them keep a shape consistent with that of the parabola, despite wind vibration or thermal expansion, according to *Science News Letter*.

The inventor is Felix Trombe, director of the National Center for Scientific Research in Paris. The furnace can produce 3,000° centigrade, and is used to study the high-temperature formation of minerals.

### *FLOWER AND COOK OBSERVATORY*

On a 31-acre site near Paoli, Pa., on high ground in a relatively thinly populated region 20 miles west of the center of Philadelphia, the University of Pennsylvania is building its new Flower and Cook Observatory. It will replace the two observatories previously operated by the university.

The first of these, the Flower Observatory, was built in Upper Darby in 1897, through a gift of R. W. Flower, who had died in 1875. This observatory was closed and sold last year because of its unfavorable location. The second observatory, bequeathed by Dr. G. W. Cook in 1940, has been on his family's estate in Wynnewood. Its 28½-inch reflector and 15-inch horizontal telescope with siderostat will be the principal instruments in the new observatory, as noted here in October, 1954.

They will be housed in an L-shaped building, with an adjoining house for the director. The style will be modern, with painted cinder-brick walls surmounted by exposed wood joists at the roof level. The dome of the reflector will be of aluminum, 27 feet in diameter, placed at the end of the longer arm of the "L." The siderostat is to have a sliding roof. The building will also contain a laboratory and workshop, a bunkroom, and darkroom.

The stationary horizontal telescope is particularly suited for use with new electronic equipment developed in co-operation with the Moore School of Electrical Engineering at the University of Pennsylvania. The chief research work at Flower and Cook Observatory, under the direction of Dr. F. B. Wood, will be on eclipsing binary stars. His principal assistants are Dr. William Blitzstein and Dr. L. Binnendijk.

### *OBSERVATORY-PLANETARIUM FOR NEW ZEALAND*

The Auckland Astronomical Society has launched a public drive to raise £250,000 to build an observatory and planetarium on the crest of Mt. Hobson, near Auckland, according to the *New Zealand Herald*. Plans call for a 12-inch reflector and a Zeiss planetarium, with accessories, buildings, and provision for upkeep and salaries. Dr. C. A. Corban, president of the society, has said that it may take a little more than a year for funds to be raised.

The observatory, to be named the Sir Edmund Hillary Observatory in recognition of Hillary's part in the conquest of Mt. Everest, will be used for research and for the public. The planetarium would be the first of its type in the British Empire as well as in the Southern Hemisphere.

### *SYMPOSIUM ON APPLIED SOLAR ENERGY*

Representatives from research, industrial, and government agencies from many parts of the world will convene in Arizona on November 1-5 to discuss the problems of the practical utilization of solar energy. A symposium has been arranged jointly

**The Adler Planetarium, first in the United States, stands on the shore of Lake Michigan in Chicago, where thousands visited it during the 1933-34 world's fair.**

by the Association for Applied Solar Energy, Stanford Research Institute, and the University of Arizona, to be held partly in Phoenix and partly in Tucson. Various solar devices will be on exhibit at Phoenix during the general sessions, while a two-day work session at Tucson will be devoted to technical papers and the discussion of the capture of solar energy.

### *MAGNETIC FIELD OF VENUS*

If Venus has a magnetic field, then when that planet is between the earth and the sun it should divert the streams of electrically charged particles coming from the sun. This effect has been sought for and found by Dr. J. Houtgast, of the Sonnenborgh Observatory at Utrecht, Holland. He has reported in *Nature* his investigation of geomagnetic character figures for the years 1884 to 1953, to find if they changed systematically near the dates of the 44 inferior conjunctions of Venus in this interval.

Magnetic disturbances on the earth are caused not only by corpuscular streams but also by solar ultraviolet radiation. Thus the corpuscular effects should be relatively more pronounced at times of small sunspot numbers. Houtgast found, in years with few sunspots, that there was a significant minimum in geomagnetic activity from about seven days before to one day after conjunction. If Venus did not have a magnetic field, but simply shielded the earth from the corpuscular stream, the depth of the observed minima should be imperceptible.

On the basis of simplifying assumptions, Houtgast estimates that the magnetic field of Venus is roughly five times stronger than the earth's. Its accurate evaluation will require further investigation, both theoretical and observational.

# *ASTRONOMICAL SCRAPBOOK*

## The Shadow of an Astronomer

AMONG the less traveled byways of astronomical literature are the medieval chronicles, which abound in mentions of celestial phenomena. The annalist of the Middle Ages, whether writing the happenings of his own times or transcribing earlier records, often varied his narrative of war and pestilence with accounts of eclipses and comets. Such interpolations are welcome to the historian, who can verify or correct dates with the aid of the eclipses and planetary conjunctions that he finds described. But there is also much of interest for the astronomer, for here are preserved descriptions of astronomical events, some too rare to occur within his own lifetime.

Take, for example, a phenomenon mentioned by the 13th-century English chronicler, Roger of Hoveden. On November 23, A.D. 755, the planet Jupiter disappeared in occultation behind the moon while the latter was undergoing total eclipse. There seems to be no recent duplication of this striking spectacle. However, a related event took place—unobservably—on June 30, 1954, when Jupiter was in occultation behind the *sun* during a total solar eclipse.

There is a particularly rich stock of astronomical records in the *Anglo-Saxon Chronicle*, which is conveniently accessible in modern English translation. This work is actually a combination of histories by several English writers, and it extends up to the year 1154. The earliest celestial event mentioned in this compilation is an eclipse of the sun in A.D. 538.

A peculiar feature of the *Anglo-Saxon Chronicle* is the brief interval, from about 1095 to 1117, when the astronomical portions of the text suddenly become much more frequent and detailed than in earlier or later years. We can recognize the nameless annalist who wrote this part of the chronicle as an astronomer.

His interest first appears in the account of a great meteor shower on April 4, 1095, when "over nearly all this land, and almost all night, numerous and manifold stars were seen to fall from heaven; not by one or two, but so thick that no man could count them." There are detailed descriptions of bright comets in 1097, 1106, 1110, and 1114, and of brilliant auroras in 1098 and 1117, when the heavens were "as if burning."

Our anonymous astronomer also records two remarkable halo phenomena. The first was in 1104, when "four circles were seen around the sun at midday, of a whitish hue, one within the other as if drawn with a compass. All that saw it wondered, for they never remembered such before." The second event was observed in 1106, on the Thursday before Easter: "There were seen two moons in the heavens before day, one in the east, the other in the west, both full, and it was the 14th day of the moon."

If this indeed is a case of a mock moon distant 180 degrees in azimuth from the actual moon, it is the lunar counterpart of the very uncommon anthelion or countersun. Such a countermoon must be still rarer, and I have never heard of another instance of it.

An important entry by this astronomer describes how the moon vanished entirely from view during the total lunar eclipse of May 5, 1110. (This seldom-observed phenomenon seems also to have happened in 1761 and 1816.) Oppolzer's list of eclipses of the moon tells us that totality lasted one hour 42 minutes, and that mid-eclipse was near 11 p.m. local time in England. According to the chronicler:

"The moon shone bright in the evening, and afterwards, little by little its light diminished, so that in the early part of the night it was so completely extinguished that neither light, nor disk, nor anything at all of it was seen. And so it continued nearly until day, and then appeared shining full and bright. It was this same day a fortnight old. All night the sky was very clear, and the stars over all the heavens shone very bright. And the fruits of trees were this night sorely nipt by frost."

Evidently an eyewitness account, this passage points strongly to one of the darkest lunar eclipses on record. A spurious disappearance of the moon from clouds seems quite ruled out by the vivid indication of radiation cooling. Through his words, we can glimpse something of the enthusiasm of an amateur astronomer gazing skyward more than eight centuries ago.

J. A.

### *AMATEUR ASTRONOMERS*

*(Continued from page 411)*

Light lunches will be served all day at the booth of the Springfield Hospital Aid Society. Picnic meals can be brought along; approved camp stoves may be used, but open fires are not permitted. There is room for overnight camping, or room reservations may be made through Hartness House, attention Mr. Merryfield, Springfield, Vt.

There is a registration fee of $2.00 for persons over 16.

JAMES W. GAGAN
Amateur Telescope Makers of Boston
Harvard College Observatory
Cambridge 38, Mass.

### CHICAGO SOCIETIES MERGE

The Chicago Astronomical Society and the Burnham Astronomical Society have announced their merger, under the name of the first. Membership now stands at 222, with an additional 70 junior members. To this may be added the Sirius Astronomical Society, a small junior club in Oak Park, Ill. Meetings are held at 3 p.m. on the second Sunday of the month (except July and August) at the Adler Planetarium, continuing the practice of the Burnham group.

Founded during the Civil War, in 1862, the Chicago Astronomical Society claims to be one of the oldest astronomical groups in the world, possibly even ranking second to the Royal Astronomical Society in Great Britain. The continuation of its long history is assured by the merger with the active Burnham society, which was organized in the early '30's.

The present officers are: president, Joseph A. Anderer; vice-president, Frank Welker; secretary, Betty Ottoson; treasurer, Russell McNeil.

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# BOOKS AND THE SKY

## METEOR ASTRONOMY

**A. C. B. Lovell.** Oxford University Press, New York, 1955. 463 pages. $9.60.

IT HAS BEEN many years since a comprehensive volume on this subject has been written in English, and the appearance of this work by Dr. Lovell will be welcomed by all serious students of meteors, comets, and associated subjects.

The author points out in his preface that he has divided the subject of meteors into two parts, which he calls Meteor Astronomy and Meteor Physics. The first part only is dealt with in the present book, and subjects such as meteor heights and decelerations, the theory of meteor luminosity, the ionization and excitation produced by meteors, trains and their formation, and all matters relating to the earth's upper atmosphere and the ballistics of meteor flight, are omitted. Meteorites also are not dealt with.

Even so the book consists of 20 meaty chapters following a brief introduction. The method of treatment is for the most part to present in condensed form the significant results of various research papers, making copious use of the figures and tables from the originals. Where conflicts in results appear the reader is usually left to form his own conclusions. Hence the book is a very excellent reference work for the professional or advanced amateur, but would be unsuitable for someone with a casual interest in astronomy who wished to find a quick answer to some question about meteors. The exact reference to each paper mentioned is placed at the bottom of the corresponding page, an editorial procedure to which I am very partial. It saves the reader a great deal of time and trouble, as papers can be identified quickly in the course of reading without the nuisance of turning to a long, confusing reference list at the end of each chapter.

Observational methods are covered in three chapters. The first deals quite briefly with visual and photographic techniques, including a description of the new super-Schmidt meteor cameras. The next two chapters give a very good summary of the history of the radio observations of meteors and the simplified theory of radio echo observing. Methods for measuring by radio the radiants and velocities of meteors are described in detail. A brief chapter gives a condensed summary of the basic equations involved in computing a meteor orbit about the sun.

The next seven chapters are concerned with the sporadic meteors. They cover in turn the diurnal and annual variations, total numbers and masses, and the velocity measures from Von Niessl-Hoffmeister, Opik, Porter, the photographic and the radio observations. In particular the statistical methods of Opik are covered very completely. In view of the radio results on faint meteors, the conclusion is drawn that very few if any sporadic meteors can come from outside the solar system.

The last nine chapters deal with meteor showers; in my opinion, this will prove to be the most valuable part of the book for many readers. In six chapters, each of 24 well-recognized showers is discussed in turn. The referencing seems very complete and the vital statistics for each shower are presented in compact form. An estimate of the total numbers of meteors and the summed mass for each shower follows, then a description of various dispersive effects acting on showers, and finally a summary of the evidence of the association between comets and meteors.

In the main body of the work, references are fairly complete up to the end of 1951 and a few 1952 papers are included. In a seven-page appendix the literature for 1952-53 is summarized. Good author and subject indexes are also given.

In general this volume is an excellent summary of our knowledge of meteors from the standpoint of classical astronomy. The coverage of the radio observations is very complete. The treatment of the photographic and the visual observations is not quite so thorough and a few omissions occur. We might mention Olivier's large compilation of telescopic meteor data and the long list of radiants observed by the American Meteor Society. There is also little or no coverage of various series of visual and photographic observations carried out prior to the war in a number of countries, including Canada, Japan, U.S.S.R., and Czechoslovakia. The Canadian co-operation in the postwar super-Schmidt photographic program is not mentioned. These omissions do not, however, affect the general conclusions drawn and so are not serious.

Two of the most interesting chapters are those where the author computes the total mass of meteoric material present near the earth in the various size categories, first for sporadic meteors, then for the shower meteors. I felt that not enough attention had been paid to the indirect evidences for large masses of very small particles, particularly in the case of the sporadic meteors.

It is fortunate indeed that a scientist of Dr. Lovell's abilities could devote the necessary effort to produce this book. I am certain it will prove to be a standard reference work for many years to come and will be very useful to both the beginner and the advanced student of meteors.

PETER M. MILLMAN
National Research Council
of Canada

## ASTRONOMY

**John C. Duncan.** Harper and Brothers, New York, 5th edition, 1955. 500 pages. $5.50.

THIS widely known textbook has been with us since 1926; it is brought up to date in this latest edition, "without changing its form or size." As for its value as a teaching tool, a reviewer can say little about a book so well established as Duncan's. Those who have been enthusiastic about the previous edition (1946) will continue to be so. The additions that bring it up to date, on the other hand, are not so extensive as to put other people's favorites out of the running.

It may be appropriate here to consider the place of an introductory textbook in the library of the amateur astronomer. Almost every branch of astronomy mentioned in this magazine, for example, is interrelated with every other branch. The amateur, especially the novice, may find a particular discussion hard to comprehend not because the matter is difficult, but because he lacks a broad perspective of astronomy. In many cases, he may miss an allusion to some other astronomical topic, not realizing its relation to the problem. One cannot say that this does harm, but the person in this position is certainly not deriving all the pleasure he could from the science.

The growth of the amateur in his science is usually not designed to overcome these difficulties. The omission is a systematic survey such as might be found in a university course. The amateur here is fortunate in having a book like Duncan's for by reading it at his own pace, he can get an excellent perspective of astronomy without the examinations and other uncomfortable aspects of a course. By skimming through the appropriate chapter, or by using the index for reference, he can quickly become the "expert," ready to enjoy his club's speaker far more than he would if he attended the lecture "cold." A textbook on astronomy is to the amateur what program notes are to the concert-goer, or what last year's batting averages are to the baseball fan.

Let us now consider Duncan's text from this point of view. It is printed and illustrated well, and is up to date. It involves very little mathematics. It is divided into sections in traditional textbook style, but these are not numbered and are variable in length. Most important of all, it is self-contained: no teacher is needed to explain what the text is trying to say.

There are no texts written in the style of a novel. The reason is that the textbook is attempting to systematize a science which is as yet incomplete, while the novelist tells only those episodes that add completeness to his story. Thus Duncan does not read like a novel. Yet the amateur should find it easy to read.

In common with most elementary texts, Duncan has too little emphasis on stellar astronomy, the part of astronomy of most interest and excitement on the modern scene. The percentage of pages devoted to topics outside the solar system is about the average of five current texts at hand. But this is less than half of the book, and it is not enough. The only recourse the student has is to read other books on specific topics; there are many excellent ones. Unfortunately, Duncan does not direct the reader to these.

I have found one typographical error: On page 174 the wave length of the series limit for the Lyman series is given as 512 angstroms instead of 912.

ROBERT FLEISCHER
Observatory of
Rensselaer Polytechnic Institute

## PHYSICAL METEOROLOGY

**John C. Johnson.** Technology Press of the Massachusetts Institute of Technology, Cambridge, Mass., and John Wiley and Sons, New York, 1954. 393 pages. $7.50.

THIS BOOK is now being used by me as a text in a graduate course in physical meteorology, covering phenomena not directly concerned with the atmospheric circulation. The reader must have a thorough grounding in general physics and calculus. In many places, full comprehension will not be reached until the reader looks up the references. The book's best features are the extensive bibliography and the detailed problems found at the end of each chapter. On the other hand, the chief drawback of the

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By Allyn J. Thompson. This book gives step-by-step instructions on how to construct a low-cost 6-inch reflecting telescope, which can use magnifications up to 250 times on the sun, moon, planets, stars, and galaxies. 211 pages, 98 figures and 6 plates, **$4.00**

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# Delivery Soon on the New UNITRON 4" Photo-Equatorial

On the back cover of the May issue we gave you an at-the-controls view of UNITRON Model 166, the new 4" Photo-Equatorial with fixed pier, clock drive, and astro-camera. Here is another view of this model which shows the complete unit.

Last month we illustrated an alternate model that uses a field tripod in place of the metal pier. Both of these new instruments will be ready for delivery very shortly. A limited number of advance orders are now being accepted. Preliminary information and tentative prices will be sent on request.

# UNITRON *owners report ...*

"I must admit that my UNITRON 2.4" Refractor is worth more than the money I have paid for it. I just thought you would be interested to know that I have found it to excel a higher priced so-called professional instrument in performance. It has been a pleasure doing business with you and I hope to continue same at some later date."

T. G., New York, N. Y.

**"Received my UNITRON 2.4" Altazimuth in perfect condition. A better work of craftsmanship I have not seen. It performs most favorably as compared to a friend's 10-inch reflector."**

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"I am a very satisfied customer. The last thing I saw built as well as the UNITRON 1.6" Altazimuth was the Model T Ford. I would have paid the price for that mounting alone. I could go on and on but I know that it has all been said before."

L. J. M., U.S.S. Haven

**"Would like to commend your workmanship on my UNITRON 2.4" Refractor. I have watched Tycho's rays brighten and dim with fine accuracy, and Saturn is a fine sight. I study Venus the most and can watch its crescent and gibbous forms wonderfully."**

**J. M., Sepulveda, Calif.**

"I feel obligated to write you about some of the results I am obtaining with my UNITRON 3" Photo-Equatorial. I have observed Uranus at its conjunction with Jupiter, and also Mars and Saturn with great satisfaction. To my astonishment I have seen at 171x a view of Venus that was almost identical to those I have had through an 11½-inch refractor on open nights at the observatory. One feature I should like to mention is the relative light weight of the instrument, which is a boon for people like me who have to carry the instrument to the observing site."

A. L., Jr., Baton Rouge, La.

**"Had my UNITRON 2.4" at the Wichita Astronomical Society picnic. About 75 people went all over it and were very enthusiastic. I could easily pick out the dark belts on Jupiter while other scopes did just fair."**

**E. V. R., Wichita, Kans.**

"The UNITRON 4" Altazimuth that I purchased recently is excellent in every respect."

E. G., Plainfield, N. J.

**"I have enjoyed doing business with your company. Your time payment plan enabled me to buy a UNITRON. It is a fine instrument and operates excellently."**

**A. C., New Orleans, La.**

*See page 437 and the back cover.*

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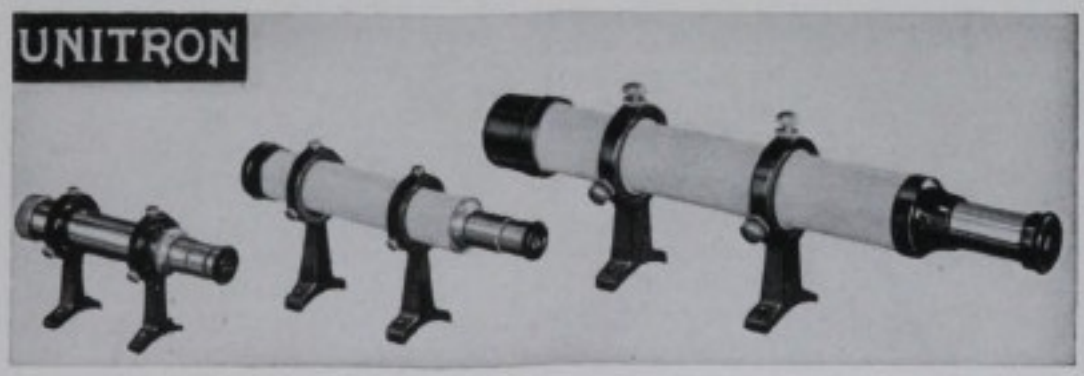


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book is its apparent unreliability due to errors in certain formulas and some physical interpretations.

The author begins by discussing atmospheric refraction of electromagnetic radiation, from visible light to microwaves. A seeming contradiction may confuse the reader on finding distances by shoran: The travel time of a wave is measured along a curved path, but the speed of the wave is based on a straight path, implied by the assumption of constant air density and index of refraction. Superior and inferior mirages are illustrated but not adequately explained. The apparent rapid rise of the moon, sun, or stars near the east horizon should be explained by the seemingly greater distances of celestial objects viewed behind a distant foreground (horizon), rather than by the decrease of refraction with increasing altitude, which actually reduces the rate of rising. An attempt to equate terrestrial and astronomical refraction fails because the quantity r has two different meanings in their developments. The author touches on a matter of great importance to astronomers when he speaks of the adverse effects of scintillation on measurements of both star magnitudes and colors.

Chapter 2 deals with scattering in the atmosphere. The diagrams depicting the scattering of light are inadequately labeled. There are some oversights in the discussion of polarization, and while the neutral points of Arago, Brewster, and Babinet are shown in a diagram, they are not explained. There are good descriptions of the color changes of astronomical bodies as they approach the horizon, and of the sky during civil and astronomical twilight.

The author next presents the theory of atmospheric visibility. There are useful graphs showing the sensitivity of the eye at different wave lengths, and a color diagram for classifying colors and finding their purity. A chart from Blackwell (1946) shows how the ability of the eye to detect brightness contrast improves greatly with increase in the angular size of the object viewed (up to 30 minutes of arc), and with an increase in the background brightness. As the author realizes, there is some confusion in calling a body that has a maximum emission of radiation at all wave lengths (corresponding to its temperature) either a white body or a black body. A body should be called white only if it reflects and does not emit light.

The chapter on radiation processes in the earth's atmosphere starts off with an interesting discussion of the sun. There are data on the brightness of the sky at different azimuths of the sun and for different solar altitudes, both from the ground and at 38,000 feet. Finally, there is a good presentation of radiation transfer in the atmosphere.

Chapter 6 returns to atmospheric optics, with information on refraction and diffraction by suspended matter. The phenomena of rainbows, fog bows, glories, haloes, and coronas are explained by optical theory. Succeeding chapters cover cloud formation, precipitation, icing of aircraft, radar meteorology, and atmospheric electricity.

The ionosphere and ozonosphere are next taken up, with a discussion of how solar flares cause ionospheric disturbances, magnetic storms, and auroras. The residual light of the night sky is attributed to atmospheric gases at high elevations, auroras, and zodiacal light. Of the night-sky spectrum, Dr. Johnson says, "First, the spectrum yields information on the composition of the high atmospheric . . . constituents, and second, the spectrum serves as a cosmic laboratory for measuring energy transformations in the atom and molecule, some of which are not duplicated easily or at all in terrestrial laboratories."

The concluding chapter, concerned with the temperature, density, pressure, and humidity of the upper atmosphere, discusses some of the methods of measurement and the results obtained. The sections on the methods by which upper-atmosphere densities can be computed from meteor and rocket observations will especially interest astronomers.

EDWARD M. BROOKS
Institute of Technology
St. Louis University

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### SUNS, MYTHS AND MEN

**Patrick Moore.** Frederick Muller, Ltd., 110 Fleet St., London E.C. 4, 1954. 192 pages. 12s 6d.

THIS book for the beginner is a lively discussion of astronomy, presented from a historical point of view, with emphasis on the solar system. It is written with a light touch that makes for extremely easy reading.

Early beliefs and myths are described concerning subjects as varied as the sun, moon, and planets; sunspots, eclipses, and auroras; and comets, meteorites, and novae. Set off against this discussion are accounts of the scientific discoveries which provided today's picture of our universe, and brief sketches of the men responsible for these advances in our knowledge. In a few pages, for instance, Tycho, Kepler, and Goodricke, and their accomplishments, are excellently delineated.

We are treated also to speculation on what the future may hold in store for space travel. Mr. Moore tells something of the early experiments leading to modern rocketry, and evaluates the progress made thus far.

The author has succeeded in conveying a large amount of astronomical information, covering a wider range of topics than an elementary textbook, without being technical at all.

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**We Sometimes Wonder**

If you know what you get in one of our slide sets? This month we're departing from our usual ads to show you. Here, for example, are all 24 slides you'll find in Slide Set 5 of the June 30, 1954, solar eclipse — already one of our best sellers.

| | |
|---|---|
| 97—Partial (minus 25 min.) | R. Rustad Jr. |
| 98—Partial (minus 20 min.) | |
| 99—Partial (minus 15 min.) | |
| 100—Partial (minus 10 min.) | |
| 101—Partial (minus 5 min.) | |
| 102—Diamond Ring (minus 3 sec.) | |
| 103—Corona | |
| 104—Prominences | |
| 105—Getting Ready for Action | A. W. Horst |
| 106—Moon's Shadow Starts | |
| 107—Moon's Shadow Advances | |
| 108—The Corona | |
| 109—Diamond Ring | |
| 110—Totality (short exposure) | |
| 111—Corona (short exposure) | |
| 112—Corona | |
| 113—Diamond Ring | O'Brien and Boyer |
| 114—Extended Corona | G. R. Wright |
| 115—Corona (short exposure) | Charles Cuevas |
| 116—Corona | |
| 117—Prominences | |
| 118—Corona | Dan Davis, Jr. |
| 119—Corona (Infrared) by German expedition in Sweden | |
| 120—Graph of Corona Intrinsic Brightness—also prominence data | Dr. Rolf Mueller (Wendelstein Obs., Germany) |

Your demand for solar eclipse slides prompted us to write the prize winners of *Sky and Telescope's* contest on last year's eclipse, and this set is the result of our inquiries. Before you buy, you may wish to refer to the September, 1954, issue of *Sky and Telescope* for more information. Chart Set 2 is also a valuable supplement to this slide set.

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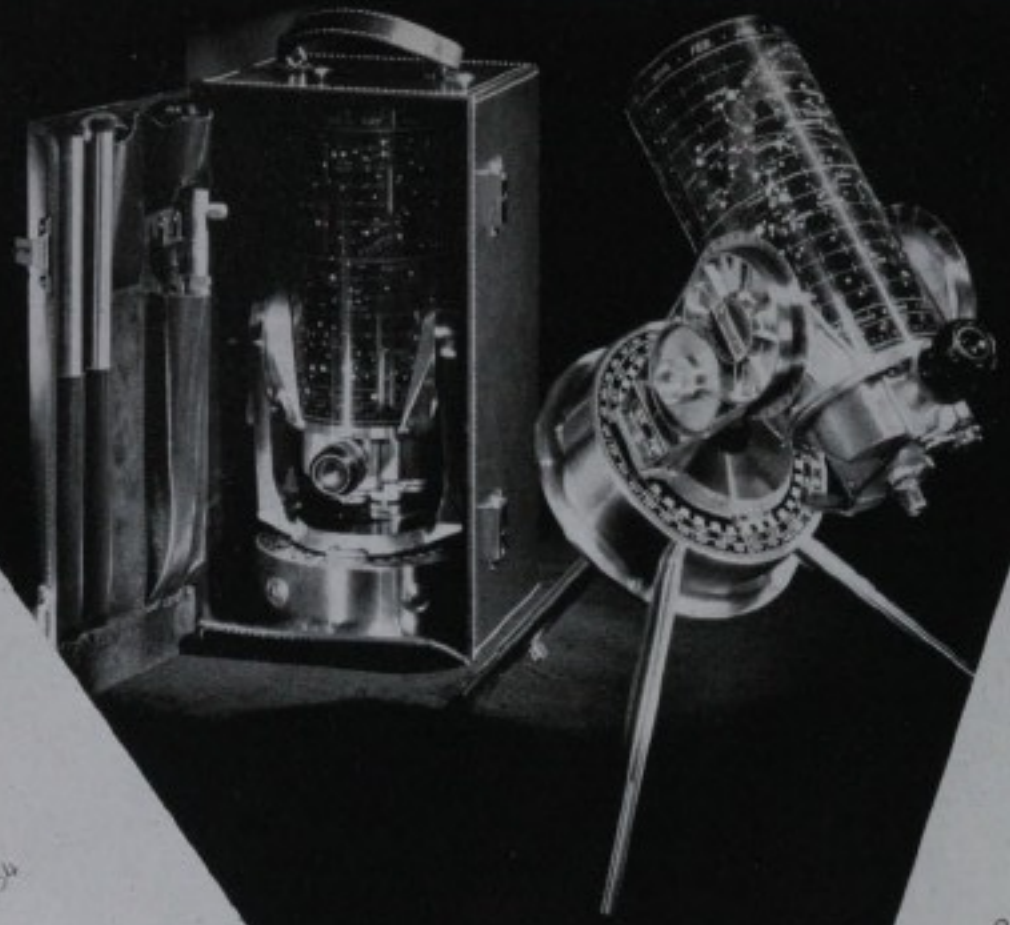

J. M. BARKER
7447 SKOKIE BOULEVARD
SKOKIE, ILLINOIS

November 19, 1954

Mr. Lawrence Braymer
Questar Corporation
New Hope, Pennsylvania

Dear Mr. Braymer:

The Questar which I bought of you in September, 1954, is the latest in a long line of binoculars and telescopes which I have used over the last forty years. I should say that the advantages of Questar which impressed me most, after its superb optical qualities, are its very light weight and compactness, the ease with which its magnifying power can be changed, the remarkable way in which the electrical drive is designed to follow celestial movements without adding to the bulk of the instrument, and the perfection of its workmanship. The fact that the light weight of the instrument is concentrated so near its center of gravity, together with the stability provided by its tripod base, means that the "dancing" of celestial images due to outside influences is reduced almost to zero. You can see from the foregoing that I am very much pleased with the Questar both for celestial and terrestial use.

Very truly yours,

J. M. Barker

CAVE OPTICAL COMPANY
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LONG BEACH 4, CALIFORNIA

Dec. 1,1954

Questar Corp.
New Hope, Penna.
Mr. Lawrence Braymer,

Dear Mr. Braymer:

This letter is to inform you of my findings regarding the quality of the Questar Optical system. We set up the coated front lens and aluminized mirror in the test rig, mounted it a few nights ago and examined image quality under actual conditions on the stars.

We are simply amazed at the perfect optical performance of the system. Star images give the perfect Airy diffraction pattern without the chromatic spread(Secondary spectrum) so common in even the best refracting telescopes. Double stars down to the Dawes's limit for the aperture were easily seperated and if "Seeing" conditions had been really good the night we observed the Dawes limit would have, I am sure, been exceeded. The Planet Jupiter showed a wealth of fine detail, and the Questar showed at least as much as a good 4" refractor.

The really nice feature of the telescope is its extreme compactness and its superb performance which makes it a telescope truly of the future.

Most cordially yours

Thomas R. Cave Jr.
Thomas R. Cave Jr.
Pres. Cave Optical Co.

P.S. We are returing the front lens and aluminized mirror, also several more perfect spherical mirrors.

QUESTAR is a beautiful and compact 20th-century telescope of great power and versatility. Its long list of patented improvements, developed during 8 years of research, make Questar revolutionary in design and performance.

All Questar's advantages stem from the ultra-compactness of its unique design. For Questar literally frees the telescope from the 18th-century form into which it has been frozen, and lifts from the telescope the ancient burden of sheer bulk and weight that has made it so awkward to set up and use, and so difficult to carry and store.

Questar's superb new optical system embodies the first basic discovery in telescope optics for the last 200 years. It excels refractors of like aperture by the absolute perfect 42-inch telephoto lens. With internal focusing to as near as 7 feet, it is the world's first long-distance microscope, a previously unknown and thrilling instrument.

The polar equatorial mounting raises Questar above a table-top to fit a person seated in the relaxed attitude of study, where in total comfort the well-nourished eye actually sees more. Electrically driven, with 6-inch sidereal clock, setting circles, clamp, fast and slow motions, the elegant Questar has every refinement of great instruments. It delivers the rock-steady image of a massive observatory telescope, yet weighs but 7 pounds. Smooth automatic following makes group demonstrations delightful. Solar work at regular class hours is safe and distortionless, with the first filter in history that keeps the sun's scorching radiation wholly outside the instrument.

Optically, Questar uses its own Cassegrain catadioptric system of 3.5-inch aperture, whose 3.8-inch spherical mirror works at f/2 only 6 inches behind a triple-passage meniscus correcting lens. Effective focal lengths of 84 or 42 inches are selected by finger-flick of lever below eyepiece. Same eyepiece delivers view-finder image as required. Powers from 40x to 160x magnification with 3-lens and 5-lens wide-field eyepieces.

Questar comes complete with accessories in imported English leather case at only $795 postpaid. Booklet on request, and your check for $200 will reserve an instrument. All inquiries welcome. Questar Corporation, New Hope, Pennsylvania.

absence of spurious color, and it is superior to reflectors by its spiderless closed tube construction and the perfection of its images over a wide field.

The photograph cannot show the deep blue jewel-like color of the engraved enamel-filled perpetual star chart, but it does indicate Questar's honest engine-turned aluminum and stainless steel.

In altazimuth form Questar travels as shown at the left, free-standing in its fitted case, fully assembled and always ready for instant use, a complete 12-pound portable observatory in ½ cubic foot. With images normally erect, rotary barrel, inclinable eyepiece, and built-in car attachment, Questar is the most versatile, convenient, and powerful terrestrial viewing scope of all time. It is a

## NEW BOOKS RECEIVED

GENERAL PRINCIPLES OF GEOLOGY, *J. F. Kirkaldy*, 1955, *Philosophical Library*. 327 pages. $6.00.

Dr. Kirkaldy's book gives a short introduction to the science of the earth. After presenting the elements of physical geology, he considers the processes that are continually altering the earth's surface. He presents a concise account of petrology and mineralogy, with a chapter on the identification of minerals. There is a section on the composition and origin of the earth, and the last third of the book treats historical and economic geology. Most of the typical formations cited are in the British Isles.

ASTRONOMY, *Freeman D. Miller*, 1955, *Bellman Publishing Co.*, Cambridge 38, Mass. 32 pages. $1.00, paper bound.

This new edition tells what the job opportunities in astronomy are, what kinds of work astronomers do and what training they need, and the rewards and disadvantages of the astronomical career from a practical viewpoint. The pamphlet is No. 72 of the series, Vocational and Professional Monographs.

THE ELEMENTS OF ASTRONOMY, *Edward Arthur Fath*, 5th edition, 1955, *McGraw-Hill*, 369 pages. $5.50.

In this fifth edition of a standard introductory astronomy text, the revisions since the last edition (1944) include rewriting of the sections on the sun, stars, and galaxies; a chapter on interstellar matter has been added. Two thirds of the book is devoted to principles, instruments, and the solar system; about 130 pages are used in covering stars, the Milky Way, and beyond. A set of charts shows stars to magnitude 4.5.

ASTRONOMICAL CUNEIFORM TEXTS, *O. Neugebauer*, editor, 1955, *Lund Humphries*, London W.C. 1. 3 volumes: 511 text pages, 255 pages of plates. £5 5s.

Prof. Neugebauer provides a scholarly edition of Babylonian tables of the sun, moon, and planets, covering the last three centuries B.C. For each of the texts he gives photographs of the original clay tablets, transcriptions, and critical analyses. While there are extended explanations of the astronomical background of this material, the general historical conclusions have been reserved for later discussion.

THE VIKING ROCKET STORY, *Milton W. Rosen*, 1955, *Harper*. 242 pages. $3.75.

Mr. Rosen, a staff member of the Naval Research Laboratory since 1940, and scientific officer in charge of development of the Viking rocket since 1947, writes a popular account of this Navy missile built for exploration of the upper atmosphere. Full stories are given of the 12 Vikings fired between 1949 and 1955.

TWO YEARS IN THE ANTARCTIC, *E. W. Kevin Walton*, 1955, *Philosophical Library*. 194 pages. $4.75.

Antarctica is of current interest to astronomers, for preparations are already being made there for the International Geophysical Year, 1957-1958, when intensive auroral, magnetic, and ionospheric observations will clarify solar-terrestrial relationships.

Mr. Walton reports informally on the British expedition of 1946-1948 to Graham Land, south of the tip of South America. The popular impression of the Antarctic is that of 30 years ago, he maintains, and his purpose is to give a more up-to-date picture.

CO-ORDINATION OF GALACTIC RESEARCH, *A. Blaauw*, editor, 1955, *Cambridge University Press*, New York. 59 pages. $1.50.

Under the sponsorship of the International Astronomical Union, a symposium was held at Groningen, Netherlands, in June, 1953, on progress and future plans for galactic research. The present volume is Dr. Blaauw's summary and analysis of these discussions. He deals primarily with the distribution and motions of stars of various types in the galactic system.

This is the first of a series of separately published reports of IAU symposia, and it is expected similar volumes will appear about once a year.

OPTICAL GLASSWORKING, *F. Twyman*, 1955, *Hilger and Watts, Ltd.*, London N. W. 1. 275 pages. 24s.

From 1904 to 1946 Mr. Twyman was managing director of Adam Hilger, Ltd. In this volume he gives detailed practical information about the methods used to make and test lenses and prisms. The book is an abridgement of the same author's *Prism and Lens Making*, a second edition of which appeared in 1952.

DIALOGUE ON THE GREAT WORLD SYSTEMS, *Galileo Galilei*, 1955, *University of Chicago Press*. 131 pages. $1.75, paper bound.

For the modern reader who wishes an easy-to-read, inexpensive edition in English of Galileo's famous classic, Prof. de Santillana has prepared this abridgement of his complete edition of 1953, which was reviewed in the July, 1954, issue on page 307.

This short version has a historical introduction and explanatory notes by its editor. Instead of merely giving selected portions, he has attempted to preserve the original argument, and, where condensations were necessary for this, they have been printed in italics.

WHEN THE STARS COME OUT, *Robert H. Baker*, revised edition, 1954, *Viking*. 182 pages. $3.50.

This is a survey of astronomy from the Chaldean shepherds to the 200-inch telescope, told for young and older readers who wish to avoid technicalities. The book first appeared in 1934.

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| 54 mm (2⅛") | 762 mm (30")..... | 12.50 | 83 mm (3¼") | 1016 mm (40")..... | 30.00 |
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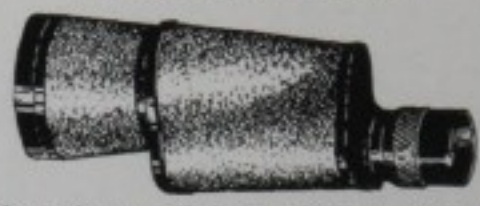
| 78 mm (3 1/16") | 381 mm (15")..... | 21.00 | 110 mm (4⅜") | 1069 mm (42 1/16") | 67.00 |

*Not coated

● We can supply ALUMINUM TUBING for the above lenses. ●

## 7 x 50 MONOCULAR



Many observers find them ideal as rich-field sky sweepers or as telescope finders. Brand new, coated optics, genuine leather plush-lined carrying case and straps. 7 power; objective is 50 mm in diameter. **$17.50**

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| 7 x 35..... | 20.75 | 7 x 50..... | 29.75 |
| 7 x 50..... | 23.75 | 8 x 30..... | 22.00 |
| 8 x 30..... | 19.00 | 10 x 50..... | 32.50 |
| 10 x 50..... | 30.25 | 16 x 50..... | 39.75 |
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This mounted eyepiece has two perfect fluoride coated lenses 29 mm in diameter. It is designed to give good eye relief. It has an effective focal length of 1¼" (8x). The eyepiece cell fits a 1¼" tube.... **$4.50**

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Known among amateurs as the "Giant Jaegers," this is the finest wide-angle eyepiece ever made. It gives a flat field. It is mounted in a focusing cell. This is an Erfle eyepiece, 1⅝" effective focal length, with a clear aperture of 2 3/16". It may be used as a Kodachrome viewer, magnifying seven times.

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22 mm (27/32") F.L. Kellner eyepiece contains cemented achromat and a non-achromatic lens.
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55 mm (2 3/16") F.L. Kellner eyepiece contains achromatic field lens and a non-achromatic eye lens.
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# GLEANINGS FOR ATM's

EDITED BY EARLE B. BROWN

## A Simple German Mounting

ILLUSTRATED here is a mounting made for a friend of mine who bought a secondhand 3-inch refractor with a homemade altazimuth head and tripod. He convinced me that all that was lacking to make him a first-class astronomer was my co-operation in providing the equatorial head.

In his back yard he erected a 4" heavy-duty pipe (not shown in the photograph) set in a good-sized block of concrete, and the head was made substantial enough to carry even a larger instrument—just in case.

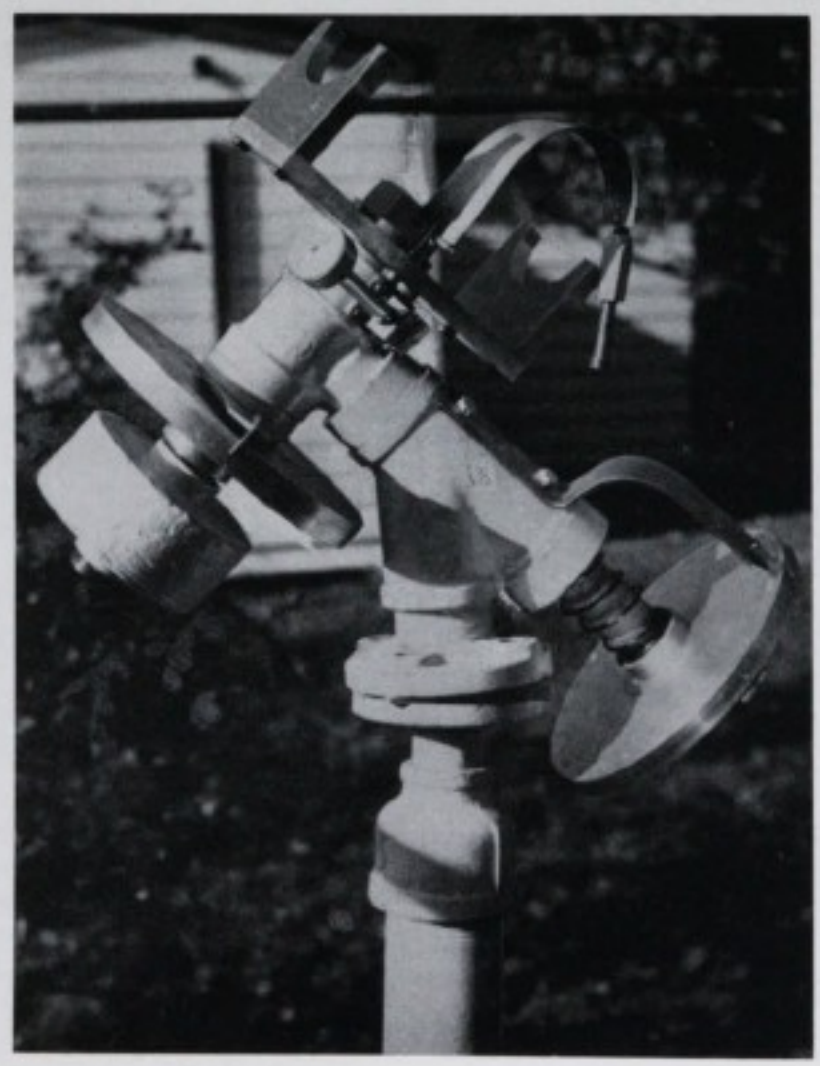
Heavy-duty pipe fittings were used and machined inside and out. The axes are monel and steel shafts, 1⅜" in diameter. The polar axle is supported by two needle bearings and ball thrust bearings at either end of the wye (Y) fitting; these latter bearings are housed by sleeves fixed to the tee (T) and wye. The declination axle moves in a solid bronze bushing extending ¾" through the tee at the lower side.

The upper side of this tee fitting is machined down to form a brake drum leaving a shoulder. On the declination axle at the saddle plate a ring, also having a shoulder, is fastened with countersunk setscrews, forming the other half of the drum. The brake band to lock both together was built up of an eccentric ring and a boss was fixed to the thicker side, but this could be a casting.

The saddle is 24 ST aluminum. A cradle piece was bored out 3" in diameter, cut in half, and machined as twin pieces to insure accuracy. The counterweight consists of lead poured around a pipe bushing, the threads being recut straight to make the counterweight adjustable on the threaded declination axle.

Since this heavy head is to be left on the pedestal, while the telescope is taken into the house, quick detaching is provided by a single hinged clamp band holding the tube fast in the open cradle. The hinge support bolt is adjustably screwed into the base plate, and the turnbuckle unit has a takeup adjustment, as seen from the picture. The head of the turnbuckle bolt engages a recessed slot in the other side of the plate that cannot be seen in the photograph.

The circles stem from an earlier attempt and are 8" in diameter with 360 divisions on the faces; the hours and degrees are stamped around the edge. The divisions were made on a 12" swing Craftsman lathe that has 60 dividing holes in the headstock. Thus, each interval had to be split six times again by auxiliary means, which led to slight discrepancies in the minor divisions. If the home worker can find a 720-mm. thin steel scale, this could be set around a dummy circle and used with a microscope of 25 power to procure accurate divisions of half a degree each. The master circle



**When mounting the equatorial head for a 3-inch refractor, Hans Pfleumer made up the difference between the standard wye of 45 degrees and the local latitude of 40°.5 north with an aluminum wedge of 4.5 degrees. The wedge may be seen between the flanges of the pier and the mount.**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would be mounted on the same shaft with the circle to be cut; on a lathe swing of 10", circles up to that size could be cut.

The time indicator bar was bent from stiff brass flat. The declination and right ascension arms in the form of cams are ⅛" aluminum. A thin saw cut was made in each end and a brass shim with a narrow slot was forced into the saw cut, notch first. With this overhanging knife edge, best seen on the declination circle in the picture, it is easy to read each circle. The declination index arm is bolted to the tee. The upper central area of the right-ascension index is padded with sheepskin (hair removed) to act as a friction clutch. The arm has a collar with setscrews to clamp to the end of the polar axle.

The hour circle floats, but it is pushed against the clutch lining by a coil spring located between the lower wye thrust bearing and a collar near the circle. This collar has a setscrew that is used to keep the spring compressed during adjustment.

The interior of the wye can be lubricated through one of the threaded holes. The declination assembly can be readily pulled out of the wye by disconnecting the right-ascension arm.

A slow motion might be added to this mount with a rubber-tired pinion gear bracketed to the pier and engaging the face of the hour circle. Although not clock driven, the mounting is useful in finding celestial objects by their coordinates with right ascension converted to hour angle.


HANS PFLEUMER
596 First Ave.
New Brunswick, N. J.

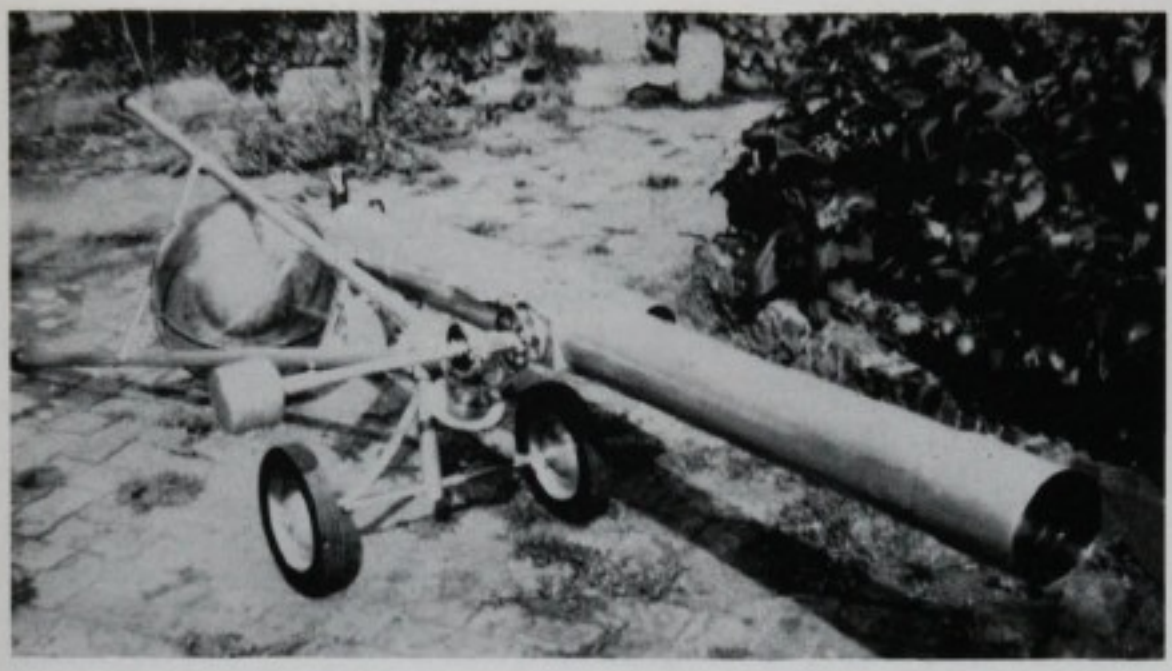

### NEW ORLEANS REFRACTOR

MY 5¼-inch equatorially mounted refractor was designed and built at home, although its objective was professionally made. It has setting circles, and slow-motion controls which unlock for free motion. The aluminum tube has a blackened lining of ⅛" cork. The focal length is 75 inches.

Three eyepieces give powers of 90, 120, and 150, which can be increased by the addition of a Barlow lens. For a finder objective I use an achromatic 3¼-inch lens of 40 inches focal length. The equatorial axes are ¾" steel shafts which turn in brass bushings.

The tripod mounting is of 1" iron pipe, and it has removable rubber-tired wheels for portability, as shown in the picture. The telescope is moved very easily for any distance by hand, or it may be towed as a trailer behind an automobile. The wheel assembly is quickly removed when the instrument is set up for observations. The wheel support screws into a 1" sleeve welded to the tripod head, and is locked in position by a ¼" bolt.

Between the tripod legs is a built-in star finder, a celestial globe of plastic, 14 inches in diameter, on which the con-



**James R. Wilson's 5¼-inch refractor is seen here mounted on its wheel assembly, ready to be moved to its observing location. The large plastic globe that serves as a star finder remains in place between the tripod legs while the telescope is being moved.**

stellations and objects of interest have been marked with india ink. A battery-powered electric light above the star finder illuminates it.

The total cost of the materials was $740, of which $425 was for the objective.

JAMES R. WILSON
821 Royal St.
New Orleans 16, La.

## GEAR COMBINATIONS FOR DRIVES

IN FEBRUARY, 1950, the writer proposed some gear-train combinations that would give driving rates somewhat slower than sidereal, in order to compensate for the effect of refraction by the earth's atmosphere. It was pointed out that a good compromise is to add about 26 seconds to the length of a sidereal day, making 23 hours, 56 minutes, and 30 seconds of mean solar time.

But one combination I suggested involved a gear with 169 teeth on the polar axis. Since a gear like that may be rather difficult to obtain, the following trains are proposed. These use gears that may be purchased from Boston Gear Works; they are of steel, 20 pitch ⅝ face. They are probably stronger than necessary, but are not too large to be suitable. The 116-tooth gear would have a pitch diameter of 5.8 inches.

A motor and gear reducer with an output shaft speed of one revolution per minute must be used. If a motor gear reducer is available that has, say, twice or half this speed, it is a simple matter to multiply a driven gear by 2 or multiply a driver by 2.

**GLEANINGS is always ready to receive reports and pictures of amateur instruments and devices, and is open for comment, contributions, and questions from its readers.**

If a 120-tooth worm gear is used, any of the following sets of gears can serve:

$\frac{1}{120} \times \frac{24}{83} \times \frac{26}{90}$ — 28 seconds slower than sidereal time

$\frac{1}{120} \times \frac{19}{69} \times \frac{27}{89}$ — 25 seconds slow

$\frac{1}{120} \times \frac{14}{37} \times \frac{17}{77}$ — 24 seconds slow

For a 100-tooth worm gear:

$\frac{1}{100} \times \frac{17}{66} \times \frac{20}{74}$ — 24 seconds slow

For a 96-tooth worm gear:

$\frac{1}{96} \times \frac{23}{89} \times \frac{30}{116}$ — 19 seconds slow

$\frac{1}{96} \times \frac{13}{56} \times \frac{19}{66}$ — 26 seconds slow

$\frac{1}{96} \times \frac{15}{67} \times \frac{20}{67}$ — 25 seconds slow

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## WHAT'S NEW AT EDMUND'S

### by Norman W. Edmund

Dear Fellows:

Take a look at the illustration of our 3" reflector. I know that your friends are always asking you for recommendations on a low-priced scope for their children, and here is one you can recommend with confidence. While the mirror is only 3 inches in diameter, it is excellent and provides fine observing. Proof of this is how well it performs with the Barlow lens that comes with the kit and with our supplementary higher power one. The equatorial mount makes it easy to follow the stars.

Seeing the crosslines in a finder scope at night is sometimes very difficult. The Army solved this problem by putting a slot in a reticle cell and then using a battery-powered grain-of-wheat lamp on the outside of the telescope. We have some slotted reticle cells complete with glass crosshair reticle, our Stock No. 40,160-Y priced at $2.00. Also a lighting unit consisting of bulb, battery cell, and cord for $2.00, our Stock No. 50,095-Y. We also have plenty of fine objectives and eyepieces, so that you can make de luxe finders at small cost.

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### PALOMAR, JR. EQUATORIAL MOUNT

This mount will help you find and "follow" a star with a minimum of effort! Point the polar axis at the North Star, adjust the tripod legs for its elevation, and tighten the lock nut. The telescope tube will now describe the same arc as a heavenly body moving through the sky.

Supplied complete with tripod legs for reflectors or refractors up to 4¼" diam. The taller tripods are used for refractors. Made of hardwood. Same mount supplied with either tripod.

Stock #85,009-Y
(Tripod legs 40" long) ..... $18.95 f.o.b.

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(Tripod legs 60" long) ..... $22.50 f.o.b.

## 6" REFLECTING TELESCOPE

Complete with heavy duty equatorial mounting and tripod. Tripod has cast aluminum head and rugged wooden legs for stability. (Folds for storage.) Equatorial mount has 1" diameter shafts with Boston bronze bearings. 5-lb. counterweight for perfect balance. Locks on both declination and polar axis. Polar axis set at 40°; latitude adjustment made with tripod legs. Black crinkle finish on mount. Telescope tube made from plastic impregnated fibre. White enamel finish on outside. Rack-and-pinion focusing eyepiece mount. 7X achromatic finder with crossline reticle. 6" Pyrex parabolic mirror—48" F.L. (f/8)—aluminized and overcoated—guaranteed to give theoretical limit of resolution. Mirror mount machined cast aluminum. Kellner eyepiece gives you 40X and a Goto combination eyepiece gives 60X and 120X. A Barlow lens is included to give 150X and 300X. Shipping weight 75 lbs.

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**A Truly Fine Instrument—**

**40X, 60X, 120X, 150X, 300X.**

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## 6" & 8" EQUATORIAL MOUNT

As Illustrated on 6" Telescope Above

Heavy ⅜" steel plate base with five ½" holes for attaching to your post or tripod. Welded construction throughout. One-inch shaft with Boston bronze bearings. Bearings and housing 6" long. 5-lb. counterweight for balance on 16"-long shaft. 1¾" diameter locking knobs on both declination and polar-axis shaft. Polar axis set at 40°; latitude adjustment made with tripod legs. 14" cradle securely holds from 4" to 10" diam. telescope tubes. Mount weighs 27 lbs. and is approximately 14" high.

Stock #85,023-Y ..... $49.50 f.o.b. Barrington, N. J.

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## 3" REFLECTOR ASTRONOMICAL TELESCOPE KIT

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## 40-90-190 POWER 3" REFRACTOR TELESCOPE

***Complete With Equatorial Mount, Tripod and Prism Finder!***

Here's a telescope bargain that uses the 3" objective described on the opposite page. Telescope is complete—no extras to buy. Look at all of these wonderful features. Erect image. Roof prism. Bends the light at 90° angle for comfortable viewing at zenith and also for terrestrial use. Three eyepieces supplied with the telescope: 6.0 mm. for high-power astronomical viewing, 12.5 mm. for medium power for viewing moon, planets, etc., and 28 mm. for low-power terrestrial and astronomical use. Small focusing eyepiece mount takes 1¼" outside diameter eyepieces. Contains built-in filters which can be changed by turning a small knob. Filters are red, yellow, neutral, and clear for use in planetary work.

The 8-power finder telescope has a real achromatic objective. Bends the image in a right angle for convenience in transferring your eye from the finder to the telescope. The heavy-duty equatorial mount can be adapted for all latitudes in astronomical viewing. It is quick and flexible for terrestrial use. Specially designed to adapt easily to slow-motion mechanism. Heavy-duty tripod adjustable for viewing at all heights. Overall length of telescope approximately 45". Shipping weight 100 lbs.

Stock #85,019-Y ..... $195.00 f.o.b. Barrington, N. J.

# EDMUND SCIENTIFIC CORP.

# ACHROMATIC ASTRONOMICAL TELESCOPE OBJECTIVES

*Real Quality at Bargain Prices*
*Make Wonderful Refractors*

For three years we checked U.S., German, and Japanese manufacturers looking for one who could produce really good telescope objectives at a low price. A few times we ordered samples only to be disappointed in quality or final price. Finally, we found a Japanese optical engineer who designed some excellent astronomical objectives. We place orders with him. He then has these made, checking each one for quality. Thus, we are able to offer objectives we believe to be as good as those selling for two or three times our price.

Our 3" and 4" diameter objectives are air-spaced achromats, as air-spacing gives the lens designer four surfaces with which to correct aberrations, instead of only three as in a cemented achromat. The results are a beautiful, color-free image, sharp, clear, with very flat field, no bad zones, and full correction against coma.

| Stock No. | Diam. | F.L. | Price | Comments |
|---|---|---|---|---|
| 30,166-Y | 3" | 45" | $28.00 | Not coated |
| 50,106-Y | 4" | 60" | 60.00 | Not coated |
| 50,107-Y | 4" | 60" | 69.00 | Coated on four surfaces |

We supply free with the 3" objective a specially designed, spiral-wound kraft board mount which is designed to slip over aluminum tubing.

For the 4" objective, a metal cell is available for $11.95. Order Stock No. 70,063-Y. This cell has a 4" I.D. and fits over our 4" O.D. aluminum tubing.

## Rack & Pinion Eyepiece Mounts

For Reflectors

For Refractors

Now you can improve performance in a most important part of your telescope — the eyepiece holder. Smooth, trouble-free focusing will help you to get professional performance. Look at all these fine features: Real rack-and-pinion focusing with variable tension adjustment; tube accommodates standard 1¼" eyepieces and accessory equipment; lightweight aluminum body casting; focusing tube and rack of chrome-plated brass; body finished in black wrinkle paint. No. 50,077-Y is for reflecting telescopes, has focus travel of over 2", and is made to fit any diameter or type tubing by attaching through small holes in the base. Nos. 50,103-Y and 50,108-Y are for refractors and have focus travel of over 4". Will fit our 2⅞" I.D. and our 3⅜" I.D. aluminum tubes respectively.

Stock #50,077-Y (less diagonal holder) $9.95 ppd.
Stock #60,035-Y (diagonal holder only) 1.00 ppd.
Stock #50,103-Y (for 2⅞" I.D. tubing) 12.95 ppd.
Stock #50,108-Y (for 3⅜" I.D. tubing) 13.95 ppd.

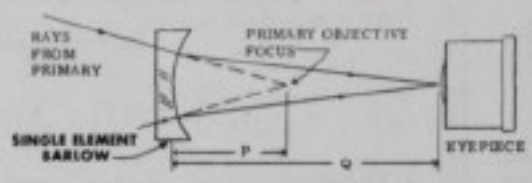
## HUYGENS EYEPIECES

Here are some really terrific values in eyepieces! The three eyepieces listed below are manufactured by one of the world's best producers of optical components. We have searched the world's markets, including Germany and France, to find a real quality eyepiece. The image clarity, the workmanship evidenced in the metal parts, will prove the skill and experience of Goto Optical Company, Tokyo. Guaranteed terrific buys at these low prices!

HUYGENS TYPE — STANDARD 1¼" DIAM.
6 mm. (¼") Focal Length
Stock #30,063-Y ..... $8.50 ppd.
12.5 mm. (½") Focal Length
Stock #30,064-Y ..... $8.00 ppd.

COMBINATION EYEPIECE—10 mm. and 20 mm.
Stock #30,065-Y ..... $9.00 ppd.

# DOUBLE AND TRIPLE YOUR TELESCOPE'S POWER with a BARLOW LENS




WHAT IS A BARLOW? A Barlow lens is a negative lens used to increase the power of a telescope without resorting to short focal length eyepieces, and without the need for long, cumbersome telescope tubes. Referring to the diagram above, a Barlow is placed the distance P inside the primary focus of the mirror or objective. The Barlow diverges the beam to a distance Q. This focus is observed with the eyepiece in the usual manner. Thus, a Barlow may be mounted in the same tube that holds the eyepiece, making it very easy to achieve the extra power.

The new power of the telescope is not, as you might suppose, due to the extra focal length given the objective by the difference between P and Q. It is defined as the original power of the telescope times the quotient of P divided into Q!

ACHROMAT OR SIMPLE BARLOW? An achromatic Barlow lens will give best results, but our low-priced single-element lens will give you 90% of the performance of the achromat. In fact, on and around the axis, the image will be just as good, with slight additional color at the edges of the field. SINGLE ELEMENT BARLOW — FOCAL LENGTH 1-5/16".

Stock #30,175-Y. Unmounted, O.D. 1-3/16". Coated. Fits in tubing listed below. $3.00 ppd.
Stock #30,140-Y. Mounted Achromatic Barlow Lens ..... $15.00 ppd.

Money Back Guarantee as with all our Merchandise!

## BRASS TUBING

2 pieces, 3" long, slide fitting. Blackened brass. I.D. 1-3/16", O.D. 1-5/16". To fit single-element Barlow above.
Stock #40,165-Y ..... $1.25 ppd.

## 7X — FINDER TELESCOPE — ACHROMATIC

Stock #50,080-Y Finder alone, less ring mounts ..... $9.95
Stock #50,075-Y Ring mounts per pr., $4.95

### ASTRONOMICAL TELESCOPE TUBING

| Stock No. | I.D. | O.D. | Lgth. | Description | Price |
|---|---|---|---|---|---|
| 80,038-Y | 4⅞" | 5¼" | 46" | Spiral-wound paper | $2.50 |
| 85,008-Y | 7" | 7½" | 60" | Spiral-wound paper | 4.00 |
| 85,011-Y | 2⅞" | 3" | 48" | Aluminum | 6.00 |
| 85,012-Y | 3⅜" | 4" | 60" | Aluminum | 8.75 |
| 85,013-Y | 4⅞" | 5" | 48" | Aluminum | 9.00 |
| 85,014-Y | 6¾" | 7" | 60" | Aluminum | 15.00 |

All tubing is shipped f.o.b. Barrington, N. J.

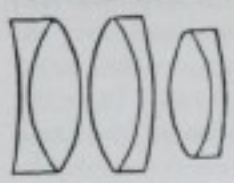
## MOUNTED ERFLE EYEPIECE

### 68° FIELD OF VIEW

Consists of 3 coated achromats in metal mount with spiral focusing. F.L. 1¼". Diam. 54 mm., length 54 mm.

War surplus. Govt. cost about $84.00. This is the type war surplus bargain that will be talked about in years to come. Buy while you can. Our price will jump soon.

Stock #5160-Y, $12.50 ppd.



## ADAPTER

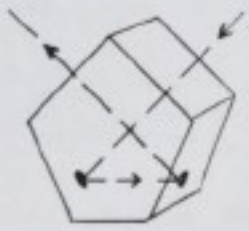
Provides 1¼" diameter mount to fit standard eyepiece holders.
Stock #30,171-Y ..... $3.95 ppd.
1¼" diam.

WAR SURPLUS **TELESCOPE EYEPIECE**

Mounted Kellner Eyepiece, Type 3. 2 achromats, F.L. 28 mm., eye relief 22 mm. An extension added. O.D. 1¼", standard for all types of telescopes. Govt. cost $26.50.

Stock #5223-Y, $5.95 ppd.

## MAKE A SUN DIAGONAL



Because it is unsilvered, this PENTA PRISM transmits only .0016 of the light it receives, making it an excellent sun viewing diagonal, if used with proper precautions. Entrance and exit faces 1" and 1" approximately.

Stock #3262-Y $3.75 ppd.

## "MAKE-YOUR-OWN" 4¼" MIRROR KIT

The same fine mirror as used in our Palomar, Jr., polished and aluminized, lenses for eyepieces and diagonal. No metal parts.
Stock #50,074-Y ..... $16.25 ppd.

## LATEST MODEL SPITZ Jr. PLANETARIUM

Designed by Armand Spitz. Projects nearly 400 stars, more than 70 constellations in their correct relationships. Use it in any darkened room of the house, project it on walls and ceiling. No batteries, works on ordinary household current. Two simple adjustments that show you the sky as it appears from any point in the Northern Hemisphere . . . for any time of night . . . for any month of the year! Rheostat brightness control. A 32-page book included free of extra cost. Contains valuable information about the stars, provides easy identification of the constellations. Also FREE — illuminated pointer.

About 14" high on a 7" x 7" base. Projection sphere 7" diameter. Weight 3 lbs. Now available supplementary spheres for Southern Hemisphere and "Sky Zoo."

Stock #70,040-Y ..... $14.95 ppd.

## SPHERICAL TELESCOPE MIRRORS

Ground, polished, aluminized, silicon monoxide overcoated. You can't buy better quality. Remember, good Spherical Mirrors of f/10 and higher, are perfectly satisfactory for reflecting telescopes.

| STOCK NO. | DIAM. | F.L. | PRICE |
|---|---|---|---|
| 50,082-Y | 3" | 30" | $9.95 |
| 50,051-Y | 4¼" | 45" | 15.00 |

## 360° SETTING CIRCLE

Made of heavy black plastic material with white markings divided into 1 degree. Numbered every 10 degrees. Diameter 4". Hole diameter 2⅞" with a ledge 3⅛". We also include, free of charge, the U.S. Air Force true air-speed computer, which is an instrument made of two disks of black plastic. Use with the setting circle if you make your own.
Stock #60,039-Y ..... $1.25 ppd.

## MISCELLANEOUS ITEMS

STAR SPECTROSCOPE — Imported! Doubles the usefulness of your Telescope. 2¾" long.
Stock #50,023-Y ..... $32.75 ppd.

60° SPECTROMETER PRISM — Polished surfaces 18 mm. x 30 mm. — flat to ½ wave length.
Stock #30,143-Y ..... $8.25 ppd.

**BE SURE TO GET FREE CATALOG "Y"**
Fantastic variety — never before have so many lenses, prisms, optical instruments, and components been offered from one source. Positively the greatest assembly of bargains in all America. Imported! War Surplus! Hundreds of other hard-to-get optical items. Write for Free Catalog "Y."

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**3" ROSS STELLARSCOPE**

**40 and 80 Power**

**Improved Model—$16.50**

Same principle as Mt. Palomar 200-inch Telescope. Exquisite definition. Knocked down.

Learn optical principles and astronomy and save money, too, by assembling your own 3" ROSS STELLARSCOPE.

Kit is complete (no lens polishing necessary) for just **$16.50** plus postage for 9 lbs.

Add a Ross Quadipod (as illustrated) for only **$18.00** more.

**PRECISE FOCUSING MECHANISM**

**For Reflectors, Refractors**

**Spiral Thread Drive**

**Takes Standard 1¼" Eyepiece**

Full 1¼" of fine focusing motion with 3" of extension tube. One revolution of knurled knob produces 0.163" motion along optical axis. Absolute centering guaranteed. No play. Will not bind or lock. No rack-and-pinion to strip. Precision manufacture allows smooth, easy positive focusing. Adapted to every type of telescope construction. Drilled to hold diagonal mirror support. Of brass throughout. Weight 1 lb. **$18.50**

**BRASS TUBING—TELESCOPING**

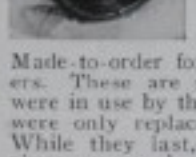
Your requests and purchases have made it possible for us to secure and supply this fine seamless brass smoothly telescoping tubing for making your own telescope parts such as oculars and focusing fittings.

1¼" O.D. wall .030" length 10".....**$1.50**

1¼" I.D. wall .030" length 10".....**$1.50**

Add 35c per length for postage

**ACHROMATIC TELESCOPE OBJECTIVES**



**4" Clear Aperture.**

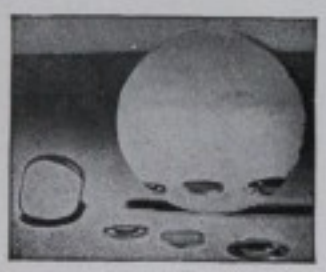
**Air-spaced in Bronze Mountings. 84" e.f.l.**

U.S. Navy surplus at less than 10% original cost. Strictly a limited supply. We will have to return your money if you are late in ordering. Don't delay! Made-to-order for lunar and planetary workers. These are not "surplus lenses." They were in use by the service for some years and were only replaced by more compact units. While they last, our price **only $59.00 each** plus express charges (collect).

**STAR DIAGONAL**

For the convenient observation of stars near the zenith, a prism is indispensable. It is placed before the eyepiece to direct the pencil of light rays so that the axis of the eye-lens is at right angles to the axis of the telescope. Our "Star Diagonal" is especially manufactured for this purpose. Fits standard 1¼" eyepiece holder and takes standard 1¼" eyepieces. Price, including fine quality light flint glass fluoride coated 1⅛" prism .....**$15.50**

Equivalent straight tube length 4".
Prism easily removed for cleaning.



**5" Telescope Mirror 67" F.L., Ground, Polished, Aluminized,** only **$13.00**

**Overstocked Selling Out Special**

Our regular 5" Aluminized Telescope Mirrors. 67" f.l. 1" blank, crown glass. Regular $17.00, while they last **ONLY $13.00 plus $1.00 P.P.**

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**HARRY ROSS**

**Telescopes - Microscopes**

*Comprehensive Catalog — $1.00; Deductible from First $10.00 Purchase.*

**70 West Broadway, New York 7, N. Y.**


# OBSERVER'S PAGE

**Universal time is used unless otherwise noted.**

## A Simple Magnitude-measuring Experiment

ESTIMATION of star magnitudes by direct visual observations is difficult for some observers. So many factors are involved, most of them of a subjective character, that some may hesitate to train themselves for such a task. This is true even though experienced observers of the American Association of Variable Star Observers have achieved such training.

A possible solution to this difficulty occurred to me at the telescope while I was illuminating the field of the eyepiece to make the reticle more visible. I noticed how faint stars disappeared from view at a given brightness level of the field. Upon reducing this brightness, the faint stars reappeared.

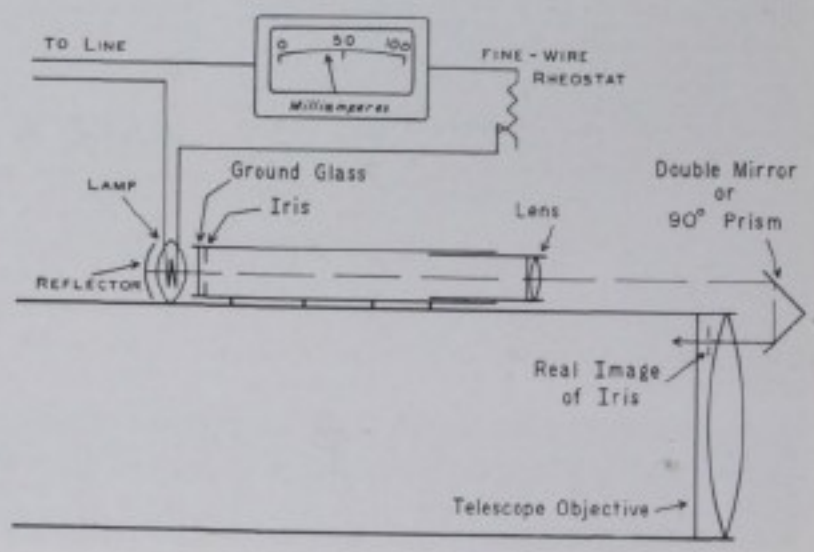
For the experiment described here, a minimum of equipment is needed, as shown in the picture and in the diagram. No modern electronic apparatus is required—just a light bulb, a rheostat, and a standard milliammeter.

Attached to the main tube is a small telescope similar to a finder but without an eyepiece. Instead, there is an iris diaphragm that may be obtained from an old camera, and behind the iris a ground glass. Close to this glass is set a small, frosted 7-watt bulb, with an opaque reflector. The current to this bulb is regulated by a fine-wire rheostat or a variable transformer and can be read on the milliammeter. The latter should be of such sensitivity that the maximum desired brightness of the lamp corresponds to a full deflection on the meter.

The light from the bulb passes through the iris and the objective of the small telescope, forward alongside the main instrument tube until it enters a small 90-degree prism or a double mirror perched on the upper edge of the main tube. The light is reflected 180 degrees down through the objective to the telescope eyepiece. The objective of the small telescope is adjusted until the image of the iris is in the plane of the main telescope objective; when this is the case, a very uniform illumination of the field of view is obtained. This method of focusing was suggested by Dr. R. Tousey, of the Naval Research Laboratory.

**Mr. Secretan's visual photometer is shown here attached to his 3-inch refracting telescope.**

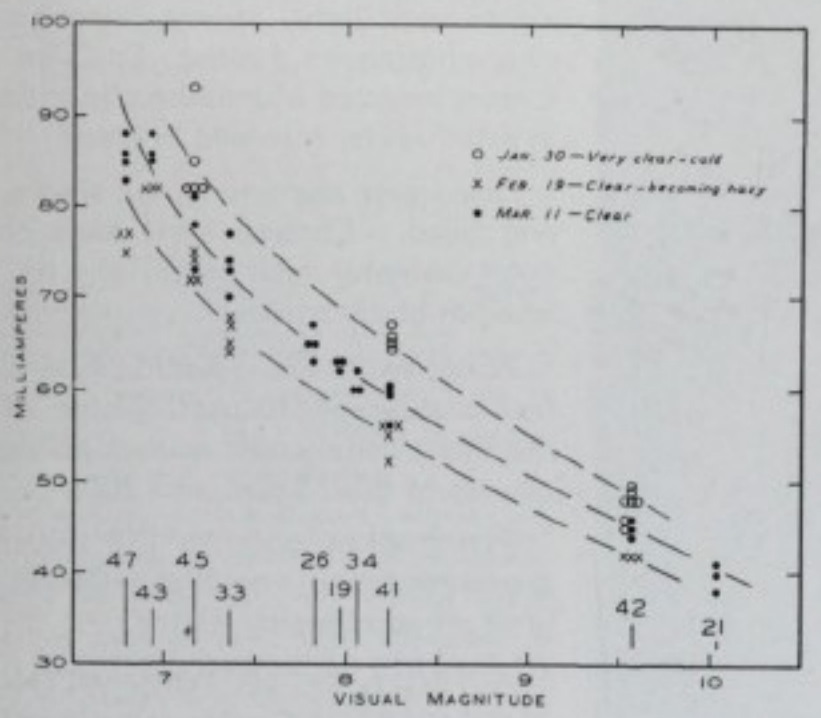
Observations may be started with a completely dark field, which is brightened with the lamp until the star under study




**This is the plan of the field illuminator developed by Luc Secretan. The main tube of the telescope is shown at the bottom, with the tube of the illuminator attached above it. Light from the lamp travels to the right before being reflected through the telescope objective.**

disappears from sight. The current passing through the lamp is then read on the milliammeter. Repetition of the reading for the same star will give the range of uncertainty, which seems to be surprisingly small, considering the simplicity of the equipment.

Using some of the stars of the Pleiades sequence as standards, with a 3-inch refractor I have obtained the observations plotted here. The range of magnitudes




**The Pleiades stars used as standard test objects during the experiments in early 1955 are identified here by their Eggen numbers (shown along the lower magnitude scale). The sequence was obtained by Mr. Secretan from the U. S. Naval Observatory through the courtesy of Dr. A. Hoag.**

is limited at the bright end by the fact that the field becomes too bright for the eye to make accurate estimates of the point of disappearance of the star. For stars brighter than the 7th magnitude, I would have to reduce the aperture of the objective or place a neutral-density filter over it.

Observations were made over a period of several weeks. I have selected the work of three nights, each with a different weather condition ranging from very clear to hazy. Each point represents one meter reading, which has been plotted against the known visual brightness of the star. The observations of each night fall roughly along a curve that is shown by the dashes. It is evident that slightly hazy nights can cut down the apparent brightness by a magnitude and more.

Note that on February 19th star 41 gave about the same readings as star 42 on the clear night of January 30th, and that star 33 appeared only about as bright as star 41. There was an apparent loss of at least a magnitude on February 19th.

Voltage variations in my source of electricity are of the order of one per cent and therefore can be neglected. The current readings were sometimes taken by the observer and sometimes by a collaborator, who did not reveal the values so the observer would not be influenced by his previous readings. In either case, the scatter was such that for two stars with a difference in magnitude of 0.2 the readings would intermingle slightly, but the averages of four readings were never equal.

As we have seen, weather conditions affect the readings very much, and it is necessary to refer constantly to a star of known magnitude, particularly as time passes and the object under observation changes position in the sky. This is a principle of stellar photometry that should be followed by anyone who tries this simple experiment.

LUC SECRETAN
3219 12th St. S.E.
Washington 20, D. C.

## AUGUST METEORS

Usually the outstanding meteor shower of the year, the Perseids may be observed from about August 4th to 16th. At maximum, this year on the 12th, the hourly number of meteors seen under particularly favorable conditions should be about 50, of which some 85 per cent will be Perseids. The moon will be past last quarter, in Taurus, and should not hinder observation seriously.

The slowly moving radiant will be at right ascension $3^h\ 04^m$, declination $+57°$, north of Gamma Persei, at maximum activity. Few Perseids are seen before midnight, but their numbers increase until dawn, as the radiant point climbs higher in the sky. These meteors are swift, often leave trains, and during a few hours of observing several brighter than Jupiter should appear. E. O.


HOW TO BUILD A QUARTZ MONOCHROMATOR

**For Observing Prominences on the Sun**

**By Richard B. Dunn**

Telescope makers will be interested in having this valuable material easily available for reference, whether or not they construct a monochromator.

*Price postpaid, 50 cents*

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**16″ Visual Newtonian**

16″ circles; 15″ gears; reversible slow motions; Cave mirror

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This is my own 16″ Visual Newtonian for sale. I am going photographic.

*Write for photo and information.*

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**TRIPLES 'SCOPE PERFORMANCE!**

Sharper images, wider field, more light at higher powers! A startling statement positively proven in 16-page telescopic educational matter sent free on receipt of self-addressed long envelope bearing nine cents (9c) return postage.

**First, the Goodwin Resolving Power lens placed in front of eyepiece gives three times the magnification on each by lengthening your primary focal length angle up to three times, yet extends eyepiece out no more than two inches from normal. This alone sharpens definition.**

**Next, by achieving your highest powers on more comfortable low-power eyepieces, you lessen image deteriorations due to short-focus acute bending of the convergent beam, since all usual eyepieces are f/1 or less. Again sharper images.**

**Third, you get greater illumination and wider field by relieving tiny aperture restrictions of higher-power eyepieces.**

The Resolving Power lens is achromatic, coated, gives flat field sharp to the edge. Here is astonishment! Price $17.50 in 4″ long adapter tube fitting standard 1¼″ eyepiece holders ONLY (but adaptable to Unitrons only. State if Unitron). Money back if not positively thrilled after two weeks trial! Used and praised by legions!

*No COD's—Colleges and Observatories may send purchase order.*

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**345 Belden Ave., Chicago 14, Ill.**

PRESENTING THE NEW MODEL "B" 8-INCH

# ASTROLA

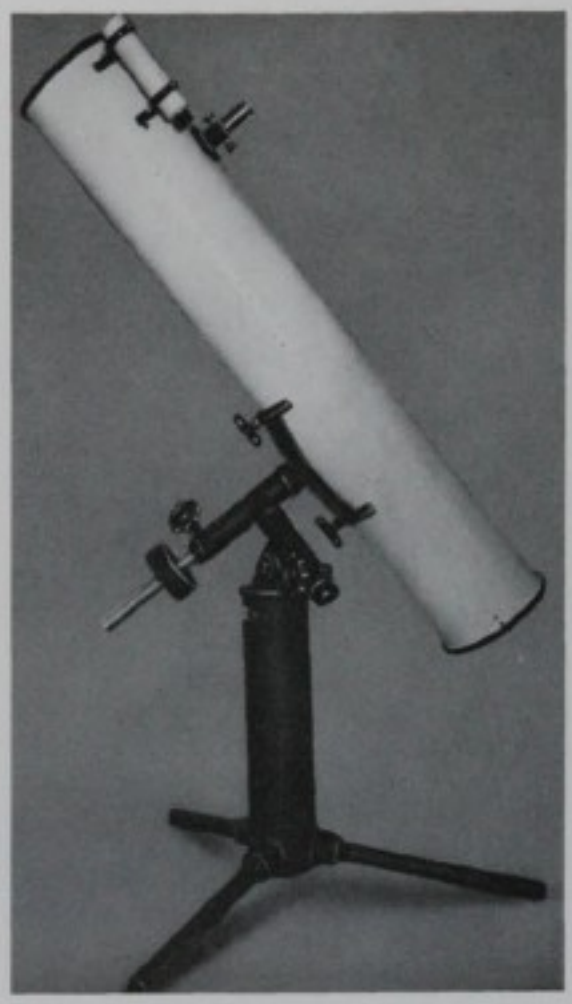
This new and improved Model "B" Reflector appeals to those who wish the finest in astronomical optics in a portable telescope. With its superb definition and excellent resolution, it is an instrument for regular research observing.

The light grasp of the 8-inch at f/7 with low power and wide field is well suited for work on variable stars, and with higher powers it gives splendid performance on lunar and planetary objects.

It weighs but 80 pounds complete and may be assembled or taken down in about three minutes.

Priced F.O.B. our plant at $375.00. Furnished with synchronous electric clock drive for $70.00 extra, if desired. Setting circles are also available.

Our Model "A", 6-inch complete telescope with three of the finest orthoscopic oculars, $295.00.



ASTROLA MODEL "B"

GENERAL DESCRIPTION OF THIS NEW MODEL: The tube is either very light, strong fiberglass or aluminum, as desired. End reinforcing rings of aluminum, finished in satin white, trimmed in black.

Heavy cast-aluminum pier, saddle, and head. Chrome steel axes of 1½" diameter. All beautifully finished in black crinkle.

Achromatic 8x, 38-mm. finder, rack-and-pinion focuser. Three of the finest orthoscopic oculars giving powers of 84x, 210x, and 360x.

Pyrex optics, good to 1/8 wave, guaranteed to split doubles to Dawes' limit on good seeing nights.

ASTROLA REFLECTORS WITHOUT MOUNTING and consisting of tube, cell, spider, finder, rack-and-pinion focuser, mirror and diagonal, with three orthoscopic oculars:

**MODEL "A"**, 6-inch ..... **$197.50**
**MODEL "B"**, 8-inch ..... **$260.00**
**MODEL "C"**, 10-inch ..... **$405.00**
**MODEL "D"**, 12½-inch ..... **$595.00**

Models "C" and "D" have rotating tubes and come with four orthoscopic oculars.

PRICES FOR COMPLETE TELESCOPES:

**MODEL "A"**, 6-inch ..... **$295.00**
**MODEL "B"**, 8-inch ..... **$375.00**
**MODEL "C"**, 10-inch ..... **$855.00**
**MODEL "D"**, 12½-inch ..... **$1050.00**
**MODEL "E"**, 16-inch ..... **$2700.00**

*All prices F.O.B. our plant, Long Beach, Calif.*

*TERMS: One half with order, balance when shipment is ready. California residents, add 3% tax.*

*Focusers, spiders, cells, and finders sold separately. Write for price list.*

## PARABOLIC TELESCOPE MIRRORS AND FLATS

Our aluminized parabolic mirrors and diagonal elliptical flats are hand corrected by Thomas R. Cave, Jr., and used by many of America's foremost observers. Guaranteed excellent performance.

**F/8 mirror and diagonal** aluminized, quartz coated, corrected to 1/8 wave. Other focal ratios slightly higher:

6" ..... $60.00  8" ..... $92.50  10" ..... $160.00  12½" ..... $250.00

**Elliptical pyrex diagonals,** aluminized and quartz coated, good to 1/8 wave:

| | | | |
|---|---|---|---|
| 1.05" minor axis | $ 6.25 | 1.78" minor axis | $14.50 |
| 1.30 " " | $ 8.75 | 2.14 " " | $18.50 |
| 1.55 " " | $11.00 | 2.61 " " | $22.25 |

*We refigure, aluminize, and coat your imperfect mirrors, and furnish them with a pyrex diagonal. Both optics good to 1/8 wave.*

CAVE OPTICAL COMPANY
4137 E. Anaheim, Long Beach 4, Calif.

## OCCULTATION PREDICTIONS

August 11-12 **Upsilon Tauri** 4.4, 4:23.6 +22-42.8, 24, Im: **H** 11:25.6 −1.0 +1.1 87; **I** 11:47.2 −0.4 +2.4 48. Em: **H** 12:35.1 −1.3 +1.7 246.

August 26-27 **b Ophiuchi** 4.3, 17:23.6 −24-08.1, 9, Im: **A** 2:22.1 −1.5 −1.0 86; **B** 2:17.7 −1.4 −0.9 80; **C** 2:17.7 −1.9 −0.9 88; **D** 2:10.0 −1.7 −0.6 78; **E** 1:48.9 −2.2 0.0 77; **F** 1:31.0 −2.8 0.0 91.

August 26-27 **51 Ophiuchi** 4.9, 17:28.7 −23-55.8, 9, Im: **F** 5:08.4 −1.3 −0.9 85; **H** 4:35.6 −1.6 +0.8 45.

September 2-3 **Kappa Piscium** 4.9, 23:-24.6 +1-00.5, 16, Em: **A** 9:22.4 −0.1 +3.3 181; **B** 9:28.4 −0.4 +1.4 199; **D** 9:23.3 −0.4 +1.8 196; **E** 9:10.4 −0.5 +2.2 194; **H** 8:32.2 −1.6 +1.4 230; **I** 8:37.6 −1.8 +0.2 266.

For stations in the United States and Canada, usually for stars of magnitude 5.0 or brighter, data from the *American Ephemeris* and the *British Nautical Almanac* are given here, as follows: evening-morning date, star name, magnitude, right ascension in hours and minutes, declination in degrees and minutes, moon's age in days, immersion or emersion; standard station designation, UT, **a** and **b** quantities in minutes, position angle on the moon's limb; the same data for each standard station westward.

The **a** and **b** quantities tabulated in each case are variations of standard-station predicted times per degree of longitude and of latitude, respectively, enabling computation of fairly accurate times for one's local station (long. **Lo**, lat. **L**) within 200 or 300 miles of a standard station (long. **LoS**, lat. **LS**). Multiply **a** by the difference in longitude (**Lo** − **LoS**), and multiply **b** by the difference in latitude (**L** − **LS**), with due regard to arithmetic signs, and add both results to (or subtract from, as the case may be) the standard-station predicted time to obtain time at the local station. Then convert the Universal time to your standard time.

Longitudes and latitudes of standard stations are:

| | | | | | |
|---|---|---|---|---|---|
| **A** | +72°.5, | +42°.5 | **E** | +91°.0, | +40°.0 |
| **B** | +73°.6, | +45°.5 | **F** | +98°.0, | +31°.0 |
| **C** | +77°.1, | +38°.9 | **G** | Discontinued | |
| **D** | +79°.4, | +43°.7 | **H** | +120°.0, | +36°.0 |
| | | | **I** | +123°.1, | +49°.5 |

## MOON PHASES AND DISTANCE

| | | |
|---|---|---|
| Full moon | August | 3, 19:30 |
| Last quarter | August | 11, 02:33 |
| New moon | August | 17, 19:58 |
| First quarter | August | 25, 08:51 |
| Full moon | September | 2, 07:59 |

| | August | Distance | Diameter |
|---|---|---|---|
| Perigee | 14, 18$^h$ | 227,400 mi. | 32′ 39″ |
| Apogee | 26, 15$^h$ | 251,200 mi. | 29′ 34″ |
| | **September** | | |
| Perigee | 10, 01$^h$ | 229,800 mi. | 32′ 19″ |

## SUPERSEEING IN MAY?

Seeing conditions are seldom satisfactory here in Alton, on the east bank of the Mississippi 20 miles north of St. Louis. Usually, the air is so turbulent that it is useless to attempt to observe double stars closer than three seconds of arc apart, with our modest reflectors of 6-inch aperture. Belts and other markings on Jupiter and Saturn are often difficult.

However, on the night of May 24th, for some unknown reason conditions were amazing. Seeing here would usually be rated as 4 or 5, but on that night it certainly was 10 out of 10. Objects viewed included Jupiter and Saturn, the double-double in Lyra, the Ring nebula, the Hercules cluster, and Polaris. In 20 years of observing, I have never seen these objects with such clarity. Three rings were seen in the Saturn system, the Hercules stars were resolved as never before, and a profusion of markings was seen on Jupiter. Observations were with a 6-inch reflector at 126 and 252 power.

The condition was so unusual for this area, that I am wondering if any other amateurs noticed it, and over what area in the Middle West it existed. Conditions the next night were back to normal, seeing 4.

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AMATEUR ASTRONOMER'S *Handbook*, $12.50, write for leaflet; Norton's *Star Atlas*, $5.25; *Bonner Durchmusterung*, northern parts, $62.50; southern parts, $38.50; Cox, *Photographic Optics*, $5.75; Wilkins, *Our Moon*, $2.75. All foreign and domestic publications. Request new list. Herbert A. Luft, 42-10 82nd St., Elmhurst 73, N. Y.

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## THE NEW COMET MRKOS

RECENT years have been lean as far as bright comets are concerned, and the discovery of a naked-eye comet, 1955e, by Antonin Mrkos on June 12th was welcome news. Working at the Skalnate Pleso Observatory in Czechoslovakia, Mrkos has been one of the most successful of today's comet hunters.

At discovery, the comet was near Capella, and of magnitude 5 or 6. It was described as a diffuse object with a central condensation or nucleus, and a tail more than a degree in length. Moving northward and eastward, it was best seen before dawn in the northeastern sky.

Word of Comet Mrkos was wired to the Copenhagen and Harvard observatories, which are the world centers for the distribution of information about newly discovered comets. The first reported accurate measurements of the comet's position were obtained at Skalnate Pleso on June 14th, at Yerkes Observatory on the 15th and 16th, and at Copenhagen on June 16th.

Reports have already been received from several American amateurs who have seen the new object. G. R. Wright, at Silver Spring, Md., picked it up on each morning from June 15th to 18th, but saw the tail on only one of these occasions. Members of the New York Amateur Astronomers Association located the comet at 3:20 a.m. on the 18th, and plotted its position as $5^h\ 20^m$, +51°.

The first computation of the orbit of Comet 1955e was by Dr. L. E. Cunningham, of the Leuschner Observatory. His preliminary elements are based on the assumption that the orbit is a parabola. At discovery, the comet was already receding from the sun, having passed perihelion on June 4th, at a distance of 0.54 astronomical unit. The orbit is inclined 86° 30′ to the plane of the earth's orbit.

During July, the path of the slowly fading comet skirts northern Lynx and passes into Ursa Major. At the beginning of August, Comet Mrkos will be an 8th-magnitude object in the constellation Canes Venatici, and will be in Bootes and about 10th magnitude by the end of the month.

In August, the comet will thus remain fairly well placed for observation. It should be visible in small telescopes, but comet magnitudes cannot be predicted with accuracy, and the figures mentioned above are only a rough guide.

The following right ascensions and declinations, given to the nearest minute and tenth of a degree, respectively, have been calculated for Comet Mrkos from Dr. Cunningham's elements. They are 1955 co-ordinates, and refer to 0$^h$ Universal time.

July 22, 11:56, +45.6; 27, 12:21, +40.5. August 1, 12:40, +35.8; 6, 12:57, +31.5; 11, 13:10, +27.7; 16, 13:22, +24.2; 21, 13:32, +21.1; 26, 13:41, +18.3; 31, 13:49, +15.8. September 5, 13:57, +13.5.

**This is the brightest comet in several years, Comet Mrkos (1955e). The picture was taken by Freeman D. Miller with the Curtis Schmidt telescope at Portage Lake, Mich., on June 18, 1955, with a 42-minute exposure. The enlargement is two times; the tail extends about two degrees on the original print. University of Michigan Observatories photograph.**

Amateurs who photograph the comet should take a check exposure the next night. This makes the comet easy to distinguish from galaxies or photographic defects.

### SUNSPOT NUMBERS

**May 1**, 28, 23; **2**, 25, 21; **3**, 32, 32; **4**, 47, 45; **5**, 35, 44; **6**, 31, 28; **7**, 23, 20; **8**, 8, 17; **9**, 0, 0; **10**, 1, 0; **11**, 0, 9; **12**, 0, 7; **13**, 1, 0; **14**, 0, 0; **15**, 0, 7; **16**, 6, 16; **17**, 17, 29; **18**, 24, 32; **19**, 29, 34; **20**, 40, 45; **21**, 48, 60; **22**, 48, 51; **23**, 42, 55; **24**, 44, 50; **25**, 44, 46; **26**, 46, 47; **27**, 33, 47; **28**, 36, 47; **29**, 34, 45; **30**, 24, 36; **31**, 20, 24. Means for May, 24.7 American; 29.6 Zurich.

Above are given the date, the American number, then the Zurich number. These are observed mean relative sunspot numbers, the American computed by D. W. Rosebrugh from AAVSO Solar Division observations, the Zurich numbers from Zurich Observatory and its stations in Locarno and Arosa.

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**See page 422 and the back cover.**

**Vive la Difference!** DON'T read this until you have seen the back cover. Look in the last column, fourth picture from the top. The UNITRON 2.4" Altazimuth Refractor in the bottom left has lost its slow-motion control knobs. A tragedy indeed—since the smooth slow motions of this exclusive UNITRON mounting are among the most noteworthy features of this popular model.

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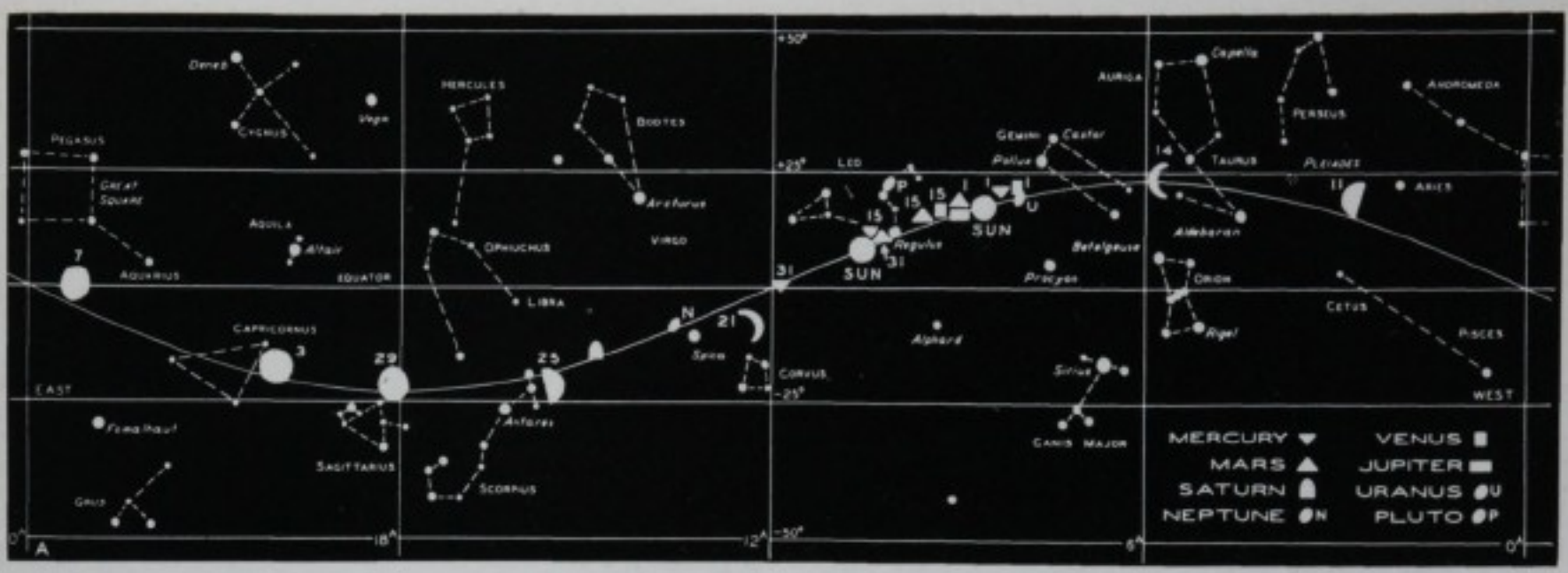


## THE SUN, MOON, AND PLANETS THIS MONTH

**The sun, on the ecliptic, is shown for the beginning and end of the month. The moon's symbols give its phase roughly, with the date marked alongside. Each planet is located for the middle of the month and for other dates shown.**

**Mercury** enters the evening sky on August 5th, passing superior conjunction with the sun. By month's end it will be visible, but only with difficulty from northern latitudes, as it is south of the sun.

**Venus** is too close to the sun for convenient observation.

**Mars** cannot be seen, as it passes conjunction with the sun on the 17th, entering the morning sky.

**Jupiter** also passes conjunction, on August 4th. It will become visible in the morning sky about the 22nd, rising an hour before the sun.

**Saturn** will be at eastern quadrature on August 8th, setting about four hours after the sun. The ringed planet is moving slowly eastward in Libra, shining at magnitude +0.8. Telescopically, the rings appear inclined 20°.9 to our view on the 15th, and their northern face is visible.

**Uranus** becomes visible in the morning sky by the end of August. This 6th-magnitude planet is in western Cancer, about 1½° southeast of the star Mu Cancri.

**Neptune** will be low in the western sky just after evening twilight. The planet moves slowly eastward toward the star 82 Virginis, passing 1½′ south of it late in the month.

E. O.

## PREDICTIONS OF BRIGHT MINOR PLANET POSITIONS

**Sappho**, 80, 9.3. Aug. 11, 23:18.7 +11-49; 21, 23:15.9 +11-46; 31, 23:10.6 +11-06. Sept. 10, 23:03.9 +9-47; 20, 22:57.3 +8-00; 30, 22:52.3 +6-01.

After the asteroid's name are its number and the magnitude expected at opposition. At 10-day intervals are given its right ascension and declination (1950.0) for 0$^h$ Universal time. In each case the motion of the asteroid is retrograde. Data are supplied by the IAU Minor Planet Center at the University of Cincinnati Observatory.

## MINIMA OF ALGOL

August 2, 12:13; 5, 9:01; 8, 5:50; 11, 2:38; 13, 23:26; 16, 20:15; 19, 17:04; 22, 13:52; 25, 10:41; 28, 7:29; 31, 4:18. September 3, 1:06; 5, 21:55; 8, 18:43.

These minima predictions for Algol are based on the formula in the 1953 *International Supplement* of the Krakow Observatory. The times given are geocentric; they can be compared directly with observed times of least brightness.

## UNIVERSAL TIME (UT)

TIMES used on the Observer's Page are Greenwich civil or Universal time, unless otherwise noted. This is 24-hour time, from midnight to midnight; times greater than 12:00 are p.m. Subtract the following hours to convert to standard times in the United States: EST, 5; CST, 6; MST, 7; PST, 8. If necessary, add 24 hours to the UT before subtracting, in which case the result is your standard time on the day preceding the Greenwich date shown.

## VARIABLE STAR MAXIMA

August 6, Z Ursae Majoris, 115158, 6.6; 8, V Canum Venaticorum, 131546, 7.1; 13, S Pictoris, 050848, 8.0; 23, R Ursae Majoris, 103769, 7.6; 25, RT Sagittarii, 201139, 7.9; 28, R Trianguli, 023133, 6.3. September 2, RR Scorpii, 165030, 6.0; 4, R Sculptoris, 012233, 5.8; 5, SS Virginis, 122001, 6.9.

These predictions of variable star maxima are by the AAVSO. Only stars are included whose mean maximum magnitudes are brighter than magnitude 8.0. Some, but not all of them, are nearly as bright as maximum two or three weeks before and after the dates for maximum. The data given include, in order, the day of the month near which the maximum should occur, the star name, the star designation number, which gives the rough right ascension (first four figures) and declination (bold face if southern), and the predicted magnitude.


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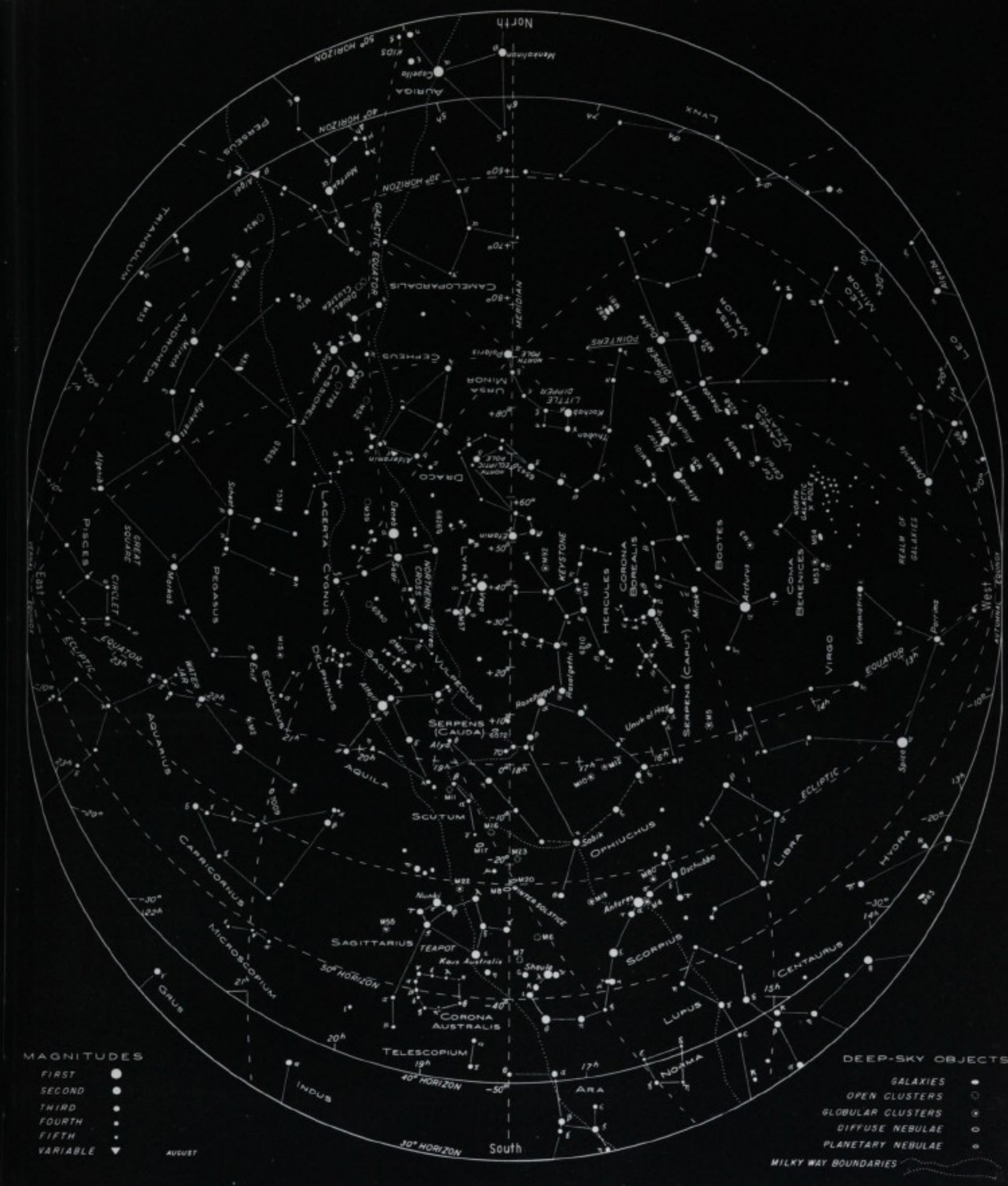
## SOUTHERN STARS

The sky as seen from latitudes 20° to 40° south, at 11 p.m. and 10 p.m., local time, on the 7th and 23rd of October; also, at 9 p.m. and 8 p.m. on November 7th and 23rd. For other dates, add or subtract ½ hour per week. When facing south, hold "South" at the bottom; turn the chart correspondingly when you are observing in other directions in the sky.

Time can be well spent this month on constellation study, while the profusion of the Milky Way lies very nearly around the horizon.




## STARS FOR AUGUST

The sky as seen from latitudes 30° to 50° north, at 9 p.m. and 8 p.m., local time, on the 7th and 23rd of August, respectively; also, at 7 p.m. on September 7th. For other dates, add or subtract ½ hour per week.

Deep in the southern sky, below the easily seen zodiacal constellation of Sagittarius, faint Corona Australis, the Southern Crown, approaches the meridian. Its brighter counterpart, Corona Borealis, is farther to the west, already across the meridian, and high in the sky.

## DEEP-SKY WONDERS

BACK in the 18th century, when Sir William Herschel's telescopes were heavier than their primitive mountings could handle, he found the "sweep" a necessary technique in compiling his great catalogues of nebulae. The telescope was kept stationary at a given declination, and the star fields were allowed to drift past.

It is still an excellent method for the amateur telescope, especially if it is not equatorially mounted or has no clock drive. It is an easy way for the beginner to find some of the fainter objects, and to acquire skill in comparing charts or photographs with the sky—a necessity in ferreting out most of the celestial wonders.

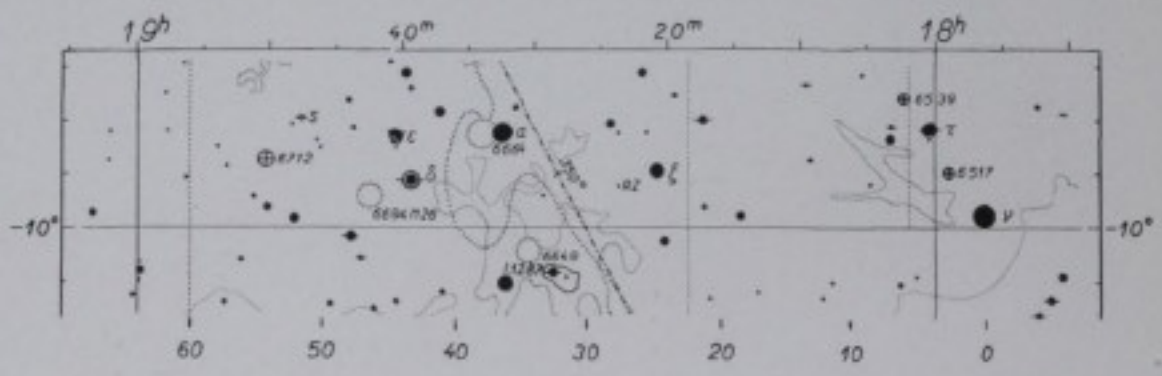
This month we list some objects that may be seen in such a sweep, starting with the 3½-magnitude star Nu (ν) Ophiuchi. Use a wide-field eyepiece. If you do not know beforehand the angular diameter of its field or that of your finder, it is well to determine these: Time how long a star (in low declination) takes to drift centrally across the field, and convert to minutes of arc by dividing the number of seconds of time by four.

Then bring Nu Ophiuchi into the field and clamp the instrument; the objects will move by in order, and at the time intervals indicated. Depending on the size of your field of view, some small careful shifts of the telescope in declination may be needed. You can tell how much shift is needed by noting the declination difference between two consecutive items in the sweep list, converting this roughly to field diameters, and using stars as reference marks in making the shift. Alternatively, if the next object will be easily recognizable, you can simply wait till its scheduled time, and then slowly move the telescope in declination, northward or southward as the case is. If you get "lost" you have only to set back on Nu Ophiuchi and begin the sweep again.

The sweep method, because it lets the eye become well dark adapted and gives ample time for looking around, will allow the amateur many additional worthwhile views as he watches the slow procession of the heavenly hosts, for this sweep runs across the lower edge of the rich Scutum shield.

WALTER SCOTT HOUSTON

| *Minutes elapsed* | *Declination* | *Object* |
|---|---|---|
| 0.0 | −9° 46′ | Nu (ν) Ophiuchi, mag. 3.5. Starting star. |
| 2.7 | −8° 58′ | NGC 6517, a small open star cluster. |
| 4.1 | −8° 11′ | Tau (τ) Ophiuchi, a double star, mag. 5.0 and 5.7, position angle 270°, separation 2″.0. With high power, easy in a 3-inch. |
| 24.6 | −8° 58′ | Zeta (ζ) Scuti, mag. 4.8. |
| 27.5 | −9° 14′ | RZ Scuti, an Algol-type variable, usually 7.7, fading to 8.9 at 15.19-day intervals. Minima will occur on the nights of Aug. 12-13, 27-28, and Sept. 11-12, 1955. |
| 34.4 | −10° 26′ | NGC 6649, a small clump of stars 9th mag. and fainter, listed by John Herschel as a cluster. |
| 36.2 | −8° 17′ | Alpha (α) Scuti, a 4.1-mag. orange star. |
| 37.7 | −8° 16′ | NGC 6664, open cluster, mag. 9. Holetschek with a 6-inch called it an 8′-by-4′ group of 10 to 15 stars of mag. 10 and 11. |
| 43.2 | −9° 06′ | Delta (δ) Scuti, mag. 4.7, with light variations in a 4½-hour period too slight to detect except photoelectrically. 10th-mag. companion, 130°, 52″. |
| 44.5 | −8° 20′ | Epsilon (ε) Scuti, mag. 5.1. |
| 46.2 | −9° 27′ | M26. Holetschek described it as a fuzzy 9th-mag. cluster about 2′ across, with an 8.8-mag. star at the preceding edge. |
| 51.3 | −8° 00′ | S Scuti, a fine orange-red star, irregularly variable between 7.0 and 8.0. |
| 54.1 | −8° 46′ | NGC 6712, a small globular cluster, mag. 9 and 2′ in diameter, according to Holetschek. |
| 55.4 | −8° 15′ | T Scuti, a red star, variable from 8.7 to 9.3. |
| 61.0 | −9° 01′ | NGC 6728, called both a poor, large cluster and a very scattered grouping of stars. |




**This strip through Ophiuchus and Scutum, reduced from the Skalnate Pleso atlas, contains the area of the sweep made by allowing the sky to drift across a stationary telescope's field of view. Right ascension is marked at the top. The figures at the bottom, with 0 at the starting star, give in minutes the time schedule for the sweep. The last two objects on the list, T Scuti and NGC 6728, are not plotted.**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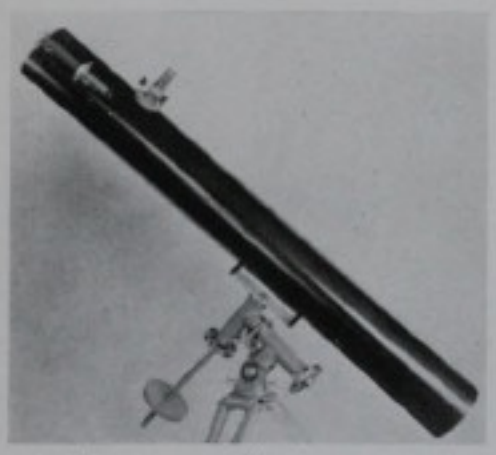

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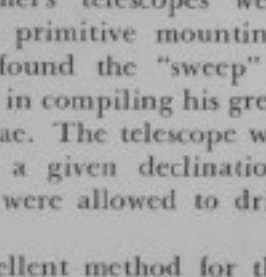

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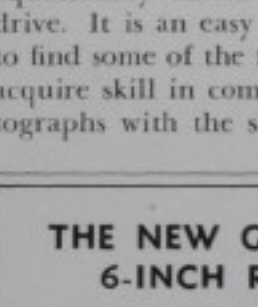

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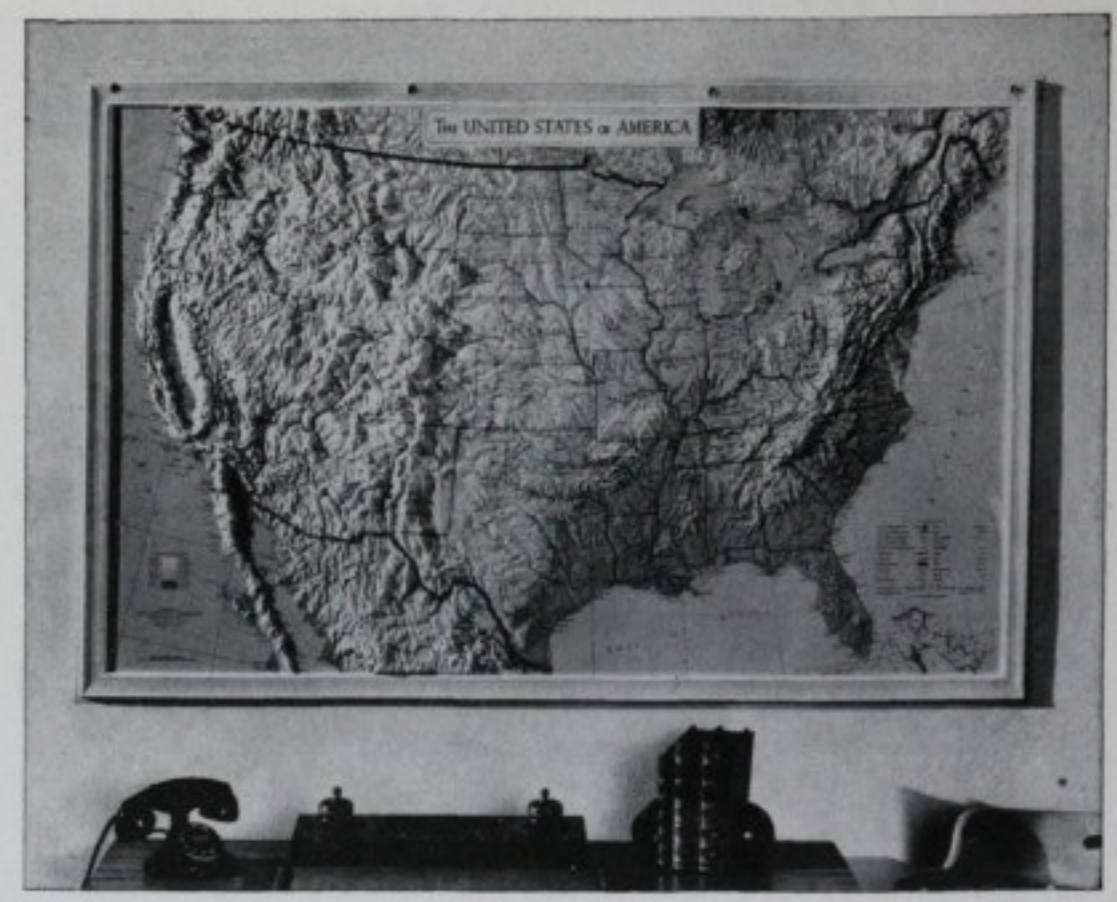


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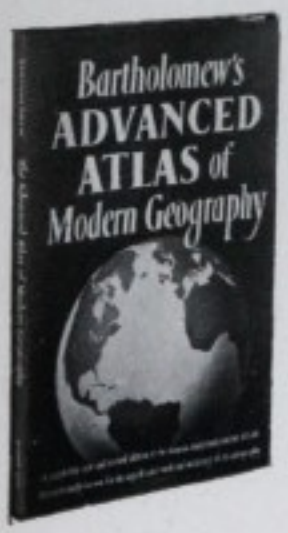


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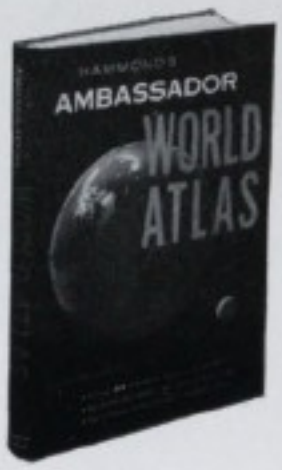


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